

SELECTED



WATER

RESOURCES

ABSTRACTS



VOLUME 2, NUMBER 24
DECEMBER 15, 1969

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is \$22.00 (domestic), \$27.50 (foreign), single copy price is \$3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.



U.S. Department of Commerce, Springfield, Va., 22151

SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior



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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD iii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

VISCOSITY DISSIPATION IN EXTERNAL NATURAL CONVECTION FLOWS,

Cornell Univ., Ithaca, N.Y.

B. Gebhart, and J. Mollendorf.

J Fluid Mech, Vol 38, Part 1, p 97-127, Aug 14, 1969. 11 p, 4 fig, 1 tab, 4 ref, 2 append. NSF Grant GK 1963.

Descriptors: *Convection, *Viscous flow, *Fluid mechanics, Heat transfer, Mass transfer, Flow, Turbulence, Laminar flow, Turbulent flow, Viscosity, Diffusion.

Identifiers: Prandtl number.

The effects of viscous dissipation are considered for external natural convection flow over a surface. A class of similar boundary-layer solutions is given and numerical results are presented for a wide range of the dissipation and Prandtl numbers. Several general aspects of similarity conditions for flow over surfaces and in convection plumes are discussed and their special characteristics considered. The general equations including the dissipation effect are given for the non-similar power law surface condition. (Knapp-USGS) W69-10091

1B. Aqueous Solutions and Suspensions

EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS--2. APPLICATIONS,

Northwestern Univ., Evanston, Ill. Dept. of Geology.

Harold C. Helgeson, Robert M. Garrels, and Fred T. Mackenzie.

Geochim et Cosmochim Acta, Vol 33, No 4, p 455-481, Apr 1969. 27 p, 11 fig, 70 ref. Work supported by Nat Sci Found, Amer Chem Society, and Northwestern Univ.

Descriptors: *Mineralogy, *Mineral water, *Aqueous solutions, *Chemical reactions, *Geochemistry, Water temperature, Pressure, Forecasting, Mass transfer, Geology, Weathering, Evaporation, Diagenesis, Hydrolysis.

Identifiers: Mineral-forming reactions.

Equilibrium relations among common rock-forming minerals and aqueous solutions over a range of temperatures and pressures are known experimentally for a number of systems and can be calculated for others. This information permits prediction of the mass transfer involved in chemical reactions characteristic of geochemical processes. Calculations of this kind are used to examine various chemical and geologic implications of irreversibility in idealized models of weathering, evaporative concentration, diagenesis, hydrothermal rock alteration and ore deposition. (Gabriel-USGS) W69-10092

SILICA IN AQUEOUS SOLUTIONS,

Akademiya Nauk SSSR, Moscow. Institut Geokhimi i Analiticheskoi Khimii.

B. N. Ryzhenko, and N. I. Khitarov.

Transl from Geokhimiya, USSR, No 8, p 957-961, 1968. Published by Geochemical Society. Geochim Int, Vol 5, No 4, p 791-795, 1968. 5 p, 3 fig, 7 ref.

Descriptors: *Aqueous solutions, *Silica, *Silicates, Water temperature, Acidic water, Alkaline water, Crystallization, Ions, Anion exchange, Metals, Electrical properties, Sodium, Potassium, Conductivity, Hydrolysis.

Identifiers: Silicate anions.

A study was made of the conductances of vapor-saturated aqueous solutions of silica and metal oxides (K, Na, and Li) at temperatures from 50 to 250 deg C. Definite structures were established for silicate anions, but an increase in Me/Si in dilute solutions causes an increase in the charge per Si atom. The same increase is observed in concentrated solutions, and is interpreted as transformation of uncharged molecular silica to ionic silica. (Gabriel-USGS) W69-10122

DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER,

Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.

For primary bibliographic entry see Field 02K. W69-10125

02. WATER CYCLE

2A. General

PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

V. Yevjevich, and R. I. Jeng.

Colo State Univ Hydrol Pap No 32, Apr 1969. 33 p, 28 fig, 5 tab, 6 ref.

Descriptors: *Statistical methods, *Time series analysis, *Markov processes, *Stochastic processes, *Probability, Synthetic hydrology, Model studies, Mathematical models, Statistics. Identifiers: Non-homogeneous hydrologic series, Consistency analysis, Homogeneity of data.

The effects of inconsistency (systematic errors) and non-homogeneity of data (man-made or natural changes in the environment) on hydrologic variables and time series are investigated. Independent sequences and first order Markov linear dependent sequences are used. Known trends are superposed on the stationary series. Changes in the probability density functions, including mean, variance, skewness, excess, and serial correlation are analytically determined for various cases of jumps and trends assumed in advance as the known non-homogeneity and/or inconsistency. Inconsistency and non-homogeneity introduce dependence into the independent series, and increase the dependence of the first order Markov linear models. Usually the first serial correlation coefficient is increased. Some forms of inconsistency and non-homogeneity may transform the one-peak probability density functions into two-peak or multi-peak density functions. Consequently, the statistical parameters of a series with inconsistent and non-homogeneous data become significantly different from those of the original series. As hydrologic time series are often subject to inconsistency and non-homogeneity, a portion of the positive dependence and the higher variance in such a series comes from these two factors. (Knapp-USGS) W69-09902

TOTAL RUNOFF TRAVEL TIME DURING THE FORMATION OF MIXED 'SURFACE-SUBSURFACE' RAIN FLOODS IN SMALL WATER COURSES,

State Hydrological Inst., Leningrad (USSR).

I. B. Vol'fson.

Transl from Trudy GGI, No 152, 1968, p 66-71. Soviet Hydrol, Selec Pap No 3, p 222-226, 1968. 5 p, 3 fig, append.

Descriptors: *Rainfall-runoff relationships, *Subsurface runoff, *Runoff forecasting, *Hydrographs, Duration curves, Floods, Flood forecasting, Infiltration, Recharge, Groundwater movement, Discharge (Water).

Identifiers: Travel time (Runoff), USSR, Valdai Hydrologic Laboratory.

Total travel time of runoff in a catchment consists of surface and subsurface runoff and channel travel time. Hydrographs for local runoff forecasting were constructed using data from experimental catchments in the Valdai Hydrologic Scientific Research Laboratory, USSR. For the watersheds measured, total travel time is directly proportional to the amount of precipitation and inversely proportional to daily average air temperature. Runoff data for the 2 experimental watersheds were collected between 1952 and 1962 and are tabulated. (Knapp-USGS) W69-09915

THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES,

Colorado State Univ., Fort Collins, Dept. of Civil Engineering.

For primary bibliographic entry see Field 06A. W69-09938

WATERSHED MANAGEMENT: EFFECTS ON BASIN DEVELOPMENT,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.

George N. Newhall, and James L. Smith.

Proc Amer Soc Civil Eng, Billings Conf, Irriga and Drainage Div, Oct 7 1965. p 47-86.

Descriptors: *Watershed management, *River basins, Water yield, Sedimentation, Hydrology, Water delivery, Snowpacks, Erosion control, California.

Identifiers: River basin development.

Watershed basin management has a significant influence upon total water yield, timing of water delivery, and upon sedimentation. Storage and loss determination for watersheds, treatments for erosion control and snowpack management are discussed. (Smith-Forest Ser) W69-09999

HYDROLOGY OF FOREST LANDS AND RANGELANDS,

Forest Service (USDA), Washington, D.C.; and Agricultural Research Service, Washington, D.C. Herbert C. Storey, Robert L. Hobba, and J. Marvin Rosa.

In Handbook of Applied Hydrology, p 22-1 to 22-52, illus, 1964. McGraw-Hill, New York.

Descriptors: *Watershed management, *Hydrologic aspects, *Hydrograph analysis, *Vegetation effects, Rainfall-runoff relationships, Peak discharge, Flood control, Erosion, Sedimentation, Watersheds (Basins), Runoff coefficient, Overland flow, Snowmelt.

Identifiers: *Fire effects, Infiltration procedure, Snowmelt analysis.

This section of the handbook was prepared for land managers, engineers, hydrologists, and others who need information on how forest and range vegetation affects the hydrologic functions of watersheds. Emphasis is placed upon explanation of the hydrologic processes undergone by water in places where forest and range vegetation can affect it. A list of definitions of terms is included. W69-10002

REPORT NO. 4: FOREST AND WATER RESEARCH PROJECT, DELAWARE-LEHIGH EXPERIMENTAL FOREST,

Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station; and Pennsylvania Dept. of Forests and Waters, Harrisburg.

Irvin C. Reigner, W. E. McQuilkin, and E. F. McNamara.

Pennsylvania Department Forests and Waters, Harrisburg, Pa., 1961. 97 p, illus.

Descriptors: *Watershed management, *Hydrologic cycle, *Forest management, *Vegetation effects,

Field 02—WATER CYCLE

Group 2A—General

*Evapotranspiration, Oak trees, Pine trees, Streamflow, Water yield, Interception, Soil moisture, Groundwater, Calibrations, Watersheds (Basins), Herbicides.

Identifiers: *Experimental watersheds, Scrub oak, Pitch pine, Soil moisture measurement, Groundwater measurement, Hydrologic analysis, Watershed calibration, Planting and seeding, Fire effects.

This is the fourth progress report on results of the scrub oak conversion studies and calibration of the Dilldown watershed. A single-watershed calibration is being developed, based on prediction of monthly and annual runoff from climatic variables. Daily streamflow, ground-water elevation, soil moisture, and climatic data are tabulated for 4 water years, October 1954 through September 1958. (Reigner-Forest Ser) W69-10005

FOREST HYDROLOGY RESEARCH IN THE UNITED STATES

Forest Service (USDA), Washington, D.C. For primary bibliographic entry see Field 09C. W69-10006

TECHNIQUES IN GRASSLAND WATERSHED RESEARCH

Forest Service (USDA), Washington, D.C. Div of Watershed, Recreation, and Range Research. E. G. Dunford. IN Proc XIV Congress Int Union Forestry Res Org., Munich, 1967. p 444-462.

Descriptors: *Watershed management, *Grasslands, *Vegetation effects, *Evapotranspiration, Overland flow, Lysimeters, Rainfall-runoff relationships, Infiltration, Precipitation (Atmospheric), Interception, Runoff, Soil erosion, Soil moisture, Sedimentation.

Identifiers: *Experimental watersheds, Sediment movement.

Research on grassland watersheds has not received as much attention as that on forest and cultivated lands, but more is needed. Many of the techniques used on other vegetation types are applicable to grasslands, but some adaptation is needed to obtain data on precipitation, interception, infiltration, and soil movement. These adaptive techniques are discussed. (Reigner-Forest Ser) W69-10007

GEOLOGIC CONTROL OF RAINFALL-RUNOFF RELATIONS IN THE PEAK CREEK WATERSHED, PULASKI AND WYTHE COUNTIES, VIRGINIA

Virginia Polytechnic Inst., Blacksburg. Dept. of Geological Science. Byron N. Cooper. Virginia Polytech Inst Water Resources Res Center Rep, May 1969. 24 p, 7 plate, 4 tab, 21 ref. OWRR Proj No A-004-VA.

Descriptors: *Rainfall-runoff relationships, *Appalachian Mountain region, *Virginia, *Geologic control, Infiltration, Groundwater movement, Surface-groundwater relationships, Hydrologic data, Gaging stations, Geology, Drainage patterns (Geologic), Geochemistry, Geomorphology, Hydrogeology.

Identifiers: *Geologic control of runoff.

Investigation of the rainfall-runoff coefficient for the Peak Creek watershed above Gatewood Dam in Pulaski and Wythe counties, Virginia, was undertaken by rain and runoff gaging of 4 easily recognized hydrogeologic terranes—each of which is composed of a part of the stratigraphic succession that possesses distinctive hydrologic characteristics. Studies of sample plots of individual hydrogeologic terranes, areas embracing 2 different terranes, 3 different terranes, and of the entire drainage area which embraces all 4 terranes provides overwhelming evidence that rainfall-run-

off coefficients for sandstone-shale terranes are higher by 40 to 80% than for other hydrogeologic terranes. In smaller watersheds in which hydrogeologic terranes with unusually high runoff factors predominate, gross underestimations of water impoundment possibilities in western Virginia are likely if the rule-of-thumb runoff coefficient of 0.30 to 0.33 is used. Geologic maps can serve very usefully as a base for deriving estimated probable rainfall-runoff coefficients for terranes similar to the 4 described in the study of the Peak Creek watershed. Runoff from Appalachian limestone-dolomite terranes is almost 1/3 that of shale-sandstone hydrogeologic terranes in the same watershed. (Knapp-USGS) W69-10104

INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS

Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.

Jonathan T. Philippe, and James M. Wiggert. Virginia Polytech Inst Water Resources Res Center Rep, Mar 1969. 30 p, 9 fig, 2 tab, 14 ref, 2 append. OWRR Proj No A-014-VA.

Descriptors: *Rainfall-runoff relationships, *Hydrograph analysis, *Unit hydrographs, *Statistical methods, *Computer programs, Streamflow forecasting, Fourier analysis, Synthetic hydrology, Analytical techniques, Runoff forecasting.

Identifiers: Harmonic analysis, IUH.

Prediction of streamflow is a primary need in hydrological application. The time span of the prediction can range from several hours or days for flood and outlet work studies to months or years for water-supply determination. Research was proposed to test the efficacy of the IUH method for short-term analysis and prediction. The method uses harmonic analysis to describe the Instantaneous Unit Hydrograph. The Instantaneous Unit Hydrograph is the curve that results when the discharge past a given point in the stream is plotted versus time, as a unit quantity of rainfall excess is released instantaneously over the watershed. Harmonic analysis expresses the form of the hydrograph function in a finite series. Some further definition work is necessary because the study results indicate inadequacies in the present details of the method. The results of the prediction calculations are highly dependent on the number of data presented in the computation. The watersheds do not always exhibit consistency in the predictor forms. Despite the problems, the method offers promise in operational streamflow prediction. The method is particularly adaptable to the digital computer, and it lends itself to continuous, real-time hydrograph computation if given data from remote sensing devices such as rain gages, weirs and groundwater monitors. A computer program and some results of computations are included. (Knapp-USGS) W69-10098

GROUND WATER SHARE OF THE WATER BALANCE AND AN EXAMPLE OF A RIVER CATCHMENT IN THE SEASIDE REGION (POLISH)

Bernard Wrobel. Polski Akad Nauk, Rozpr Hydrotech, Part 23, p 227-237, 1969. 11 p, 4 fig, 5 tab.

Descriptors: *Water balance, *Groundwater, *River flow, Hydrologic properties, River basins, Geology, Geomorphology, Mountains, Altitude, Watersheds (Basins), Precipitation (Atmospheric), Water loss, Infiltration, Surface flow.

Identifiers: *Poland, Water balance (Groundwater share).

The share of groundwaters in the water balance was investigated by using the hydrogeological data of the Reda and Zagorska Struga Rivers of Poland. The study shows the presence of geological old valleys dividing the basins of these 2 rivers into 2

geomorphologically different structures. By merging these 2 river basins into a single river basin on the basis of their geological similarity and their appearance as a single stream in their lower reaches, the analysis of the hydrologic data shows that the mean annual precipitation of this combined catchment area of 640 sq km is 644.5 mm with 11.8% utilized for ground retention, 23.4% for surface runoff, and 64.8% considered as the water loss. (Gabriel-USGS) W69-10104

DEVELOPED EQUATION OF THE WATER BALANCE (POLISH)

Kazimierz Debski.

Polski Akad Nauk, Rozpr Hydrotech, Part 23, p 45-50, 1969. 6 p, 2 tab, 5 ref.

Descriptors: *Water balance, *River basins, *Mathematical studies, Runoff, Surface runoff, Soils, Zoning, Water loss, Precipitation (Atmospheric), Water circulation, Water supply, Infiltration, Evapotranspiration, Evaporation, Vegetation.

Identifiers: River basin water balance.

This article develops a more sophisticated water balance equation applicable to a river basin on the basis of analyzing the water balance equation as consisting of two parts, i.e. the surface and groundwater zones. A phenomenon of infiltration is considered to be the only hydrologic property which serves as a connecting link between these two zones. The use of this sophisticated water balance leads to reliable interpretations of water circulations in continental areas and, especially, to the evaluation of groundwater recharge as a result of precipitation infiltration. The same equation permits the quantitative determination of the transpiration process. (Gabriel-USGS) W69-10108

POTENTIALLY BIGGEST RUNOFF FROM TORRENTIAL RAINFALLS (POLISH)

Kazimierz Debski.

Polski Akad Nauk, Rozpr Hydrotech, Part 23, p 51-64, 1969. 14 p, 4 fig, 4 tab, 9 ref.

Descriptors: *Rainfall, *Runoff, *Streamflow, Watersheds (Basins), Topography, Forecasting, Altitude, High water mark, Low water mark, Storm runoff, Synoptic analysis, Mathematical studies.

Identifiers: *Poland, Torrential rainfall runoff.

Stream runoff, as a result of torrential rainfalls, was analyzed on the basis of the data recorded by Polish hydrological gaging stations. The maximum runoff, as a result of a torrential rain, is very different from a runoff formed by spreading rains. These 2 types of rain runoff cannot be expressed by a single formula common to these 2 phenomena. The peak rate of storm runoff increases with the growth of water basin and can be well represented by a definite monotonic function, whereas the peak runoff from a spreading rain increases with an increase in the water basin area, according to a definite parabolic function. The study also shows that under the same physiographic conditions the peak rate of a storm runoff in small basins is greater than that from spreading rains. In evaluating the runoffs from their corresponding rainfalls the Pagliari formula was adapted as the most suitable for the hydrogeological conditions prevailing in the Polish areas. (Gabriel-USGS) W69-10112

THE PROBLEM OF THORNTHWAITE AND MATHER'S METHOD OF WATER BALANCE IN ITS APPLICATION TO POLAND (POLISH)

Polish Academy of Sciences, Warsaw. Inst. of Geography.

Krzysztof Wojciechowski.

Pol Akad Nauk, Int Geogr Prace Geogr No 68, 1968. 80 p, 31 fig, 11 tab, 81 ref.

Descriptors: *Water balance, *Hydrologic cycle, *Mathematical studies, Climates, Climatic data, Water loss, Water supply, Recharge, Low water mark, High water mark, Gaging stations, Mountains, Altitude, Storage capacity, Precipitation (Atmospheric), Evapotranspiration, Dynamics. Identifiers: Thornthwaite and Mather's water, Water balance method.

The application of Thornthwaite and Mather's method for the study of water balance of Polish territory was investigated using data from 159 hydrologic stations located at altitudes below 500 m. The mountain regions of the territory have been left out of consideration in the belief that for them the water balance pattern would fail to illustrate fully their differentiation in hydrologic features. The calculations were based on recorded climatic data, using normal mean values, and assuming the water storage capacity of the soil to be 200 mm. The water balance evaluated by using the Thornthwaite and Mather method, gives a good understanding of the interrelation of the water supply and water needs, and the effect of soil retention on this interrelation. Several areas exist where both water-deficiency and water-surplus types predominate. (Gabriel-USGS)

W69-10127

INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR,

State Hydrological Inst., Leningrad (USSR).

A. A. Kapotov.

Transl from Trudy GGI, No 152, 1968, p 79-92. Soviet Hydrol, Selec Pap No 3, p 227-237, 1968. 11 p, 5 fig, 7 tab, 10 ref.

Descriptors: *Frost, *Freezing, *Soils, *Frozen ground, *Forecasting, Planning, Runoff forecasting, On-site investigations, On-site data collections, Rainfall-runoff relationships.

Identifiers: *USSR, Valdai Hydrologic Laboratory, Frost depth forecasting.

Methods were developed at the Valdai Hydrologic Scientific Research Laboratory, USSR, to predict seasonal soil freezing depth, which must be taken into account in predicting spring runoff, water balance calculations, and in many engineering projects. Freezing characteristics are also necessary in estimating growth and planting time of crops. Data were collected at Valdai, Pskov, Novgorod, and Moscow between 1951 and 1967. Freezing depth was determined by permafrost meter and by trenching. In the areas studied, the depth of freezing depends largely on the type of vegetation. In fields the depth is greater by a factor of 1.5 to 2 than in the forests, averaging 33 cm in fields and 15 cm in forests. In severe winters, field soils freeze about 20-25 cm deeper than forest soils, and in mild winters, 5-15 cm deeper. Deepest freezing is in plowed fields where it averaged 42 cm. Minimum depths are in waterlogged forested ravines, which average 14 cm. Sandy soils freeze deeper than loamy soils. The main weather factors affecting freezing are air temperature and snow depth. Under deep snow, soils often remain unfrozen all winter. Freezing depth relations are summarized both by empirical equations and graphically. Comparisons with field data show that the relations are reasonably accurate for forecasting. Probability curves were plotted for several areas and were found to predict freezing depths fairly well. (Knapp-USGS)

W69-10132

SHORT-RANGE FORECASTING OF LOWLAND-RIVER RUNOFF,

Gidrometeorologicheskii Institut, Leningrad (USSR).

Yu. M. Alekin.

Available from the Clearinghouse as OTS Transl No 61-11468, \$3.00 in paper copy, 0.65 in microfiche. Transl from Gidrometeorologicheskoe Izdatel'stvo, Leningrad, 1956. 229 p, 100 fig, 24 tab, 191 ref.

Descriptors: *Streamflow forecasting, *Runoff forecasting, Water balance, Rainfall-runoff relationships, Statistical methods, Hydrograph analysis, Gaging stations. Identifiers: *USSR, Isochrone method, Tendency method, Textbook.

The main methods of short-range riverflow forecasting used in the USSR are described in a textbook for a course, Hydrological Forecasting of River Runoff, for university hydrometeorology students. The tendency, corresponding-stage, isochrone, and water-balance methods are described as well as statistical methods for evaluating short-range forecasts. (Knapp-USGS)

W69-10146

METEOROLOGICAL AND HYDROLOGICAL DROUGHT IN RARITAN RIVER BASIN IN NEW JERSEY,

Rutgers - The State Univ., New Brunswick, N. J. Water Resources Research Inst.

Chin S. Liu, and W. B. Snow.

Available from ASME, 345 East 47th St., New York, 10017, for \$1.50 per copy. Order as 69-PID-3. ASME/AICHE Water Pollution Conference, Rutgers University, New Brunswick, New Jersey, June 1969. 6 p, 3 tab, 6 fig. OWRR Project A-002-N.J.

Descriptors: *Droughts, Water balance, Hydrologic data, Sequential generation.

The 1961-66 drought in the Northern part of New Jersey was the most intense ever recorded in the region. The meteorological droughts, indicated by the Palmer Drought Index, and the corresponding hydrological droughts were investigated. The drought sequence is a time series characterized by a Markov chain process. Long sequences of generated drought data were utilized for evaluating the various drought distributions. (Liu-NY)

W69-10184

2B. Precipitation

RECORDED OBSERVATIONS ON THE INFLUENCE OF CLOUDINESS AND WIND VELOCITY ON THE BRIGHTNESS OF THE DAYLIGHT SKY ABOVE THE WATER SPACE (RUSSIAN),

A. N. Rayevskiy.

Izv Akad Nauk, SSSR, Fiz Atmos i Okeana, Vol 5, No 5, p 539-542, May 1969. 4 p, 1 fig, 4 tab, 2 ref.

Descriptors: *Cloud cover, *Wind velocity, *Light intensity, *Surveys, Photometers, Instrumentation, Light quality, Wavelengths, Altitude, Fog, Temperature, Water temperature, Atlantic Ocean, Aerosols.

Identifiers: Daylight brightness (Atlantic Ocean).

The effect of cloudiness and wind velocity on the brightness of the sky over broad water surfaces was investigated by recording the observations during the R/V 'Sedov' expedition in the Atlantic and Arctic Oceans. The observations were made by using an integral photoelectric photometer of effective wavelengths of 0.550, 0.660 and 0.890 mkm. The brightness intensity increases with the increase of wind velocity for all wavelength values and the presence of water dust in the atmosphere begins to be significant for a wind velocity of about 15-16 m/sec. (Gabriel-USGS)

W69-09899

2C. Snow, Ice, and Frost

GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECESSION IN THE NARVIKSKJOMEN DISTRICT, NORWAY,

Uppsala Univ. (Sweden). Dept. of Physical Geography.

Ragnar Dahl.

Norsk Geograf Tidskr, Vol 22, p 101-165, 1968. 165 p, 47 fig, 2 tab, 55 ref.

Descriptors: *Glacial drift, *Glaciers, *Regimen, *Ablation, *Drainage, Sediments, Glacial soils, Ice, Altitude, Lakes, Watersheds (Basins), Climates, Topography, Fjords, Carbon, Radioactivity, Shores, Deltas, Mapping, Geology, Erosion, Dating. Identifiers: *Norway, Narvik-Skjomen District.

Glacial accumulations and other phenomena of the Narvik-Skjomen District of Norway are discussed on the basis of geological data and the use of earlier publications. The study shows that most of the late-glacial accumulations at low levels in these districts are ice-front deltas or delta moraines. Thus these accumulations cannot be correlated with the drainage of any large ice-dammed lakes east of the watershed, as has earlier been maintained. Repeated beds of moraines on stratified sediments indicate that there were small climatic fluctuations, but the different accumulations are not synchronous. The ages of the investigated ice-front accumulations have been calculated on the basis of shorelines and some C-14 dating, showing that the heads of the fjord valleys were deglaciated at low levels as early as 7900-7500 B. C. (Gabriel-USGS)

MOISTURE MOVEMENT TO A FREEZING FRONT,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 02G.
W69-09928

INSTRUMENTATION FOR SNOW GAGING -- YESTERDAY, TODAY, AND TOMORROW,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-09992

SNOW EVAPORATION REDUCTION: MIGRATION OF EVAPORATION SUPPRESSANTS THROUGH SNOW,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-09993

GAMMA-TRANSMISSION PROFILING RADIOSOLOPE SNOW DENSITY AND DEPTH GAGE,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-09994

ISOTOPE SNOW GAGES FOR DETERMINING HYDROLOGIC CHARACTERISTICS OF SNOWPACKS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-09995

ISOTOPES -- A MULTIPURPOSE TOOL FOR FOREST WATERSHED RESEARCH,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-09996

PORTABLE RADIOACTIVE ISOTOPE SNOW GAGES FOR PROFILING SNOWPACKS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-09997

TRANSPORT OF INTERCEPTED SNOW FROM TREES DURING SNOW STORMS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
David H. Miller.

Field 02—WATER CYCLE

Group 2C—Snow, Ice, and Frost

US Forest Service Res Paper PSW-33, Pacific Southwest Forest and Range Experiment Station, Berkeley, California, 1966. 30 p.

Descriptors: *Snow, Melt water, Hydrology, Watershed management, Winds, Solar radiation, California, *Interception, Stemflow.

Identifiers: Vapor flux, Intercepted snow.

Five principal processes by which intercepted snow in trees is removed during snow storms are described: vapor flux from melt water, vapor flux from bodies of snow, stem flow and drippings of melt water, sliding of bodies of intercepted snow from branches, and wind erosion and transport of intercepted snow. (Smith-Forest Service) W69-09998

A GAMMA-TRANSMISSION GAGE FOR PROFILING SNOWPACK,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 07B. W69-10000

MEASUREMENT OF SNOWPACK PROFILES WITH RADIOACTIVE ISOTOPES,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 07B. W69-10001

PERMAFROST AND RELATED ENGINEERING PROBLEMS IN ALASKA,
Geological Survey, Washington, D.C.
Oscar J. Ferrians, Jr., Reuben Kachadoorian, and Gordon W. Greene.
Geol Surv Prof Pap 678, 1969. 37 p, 36 fig, 4 tab, 28 ref.

Descriptors: *Permafrost, *Engineering geology, *Soil water, *Alaska, Foundations, Soil mechanics, Arctic, Frozen ground, Cold regions, Ice, Tundra, Subsidence.

Identifiers: Permafrost engineering, Thermokarst, Polygonal ground, Ice wedges, Pingos.

Permafrost, or perennially frozen ground, is a widespread natural phenomenon. It underlies approximately 20% of the land area of the world. The permafrost region of Alaska, which includes 85% of the State, is characterized by a variety of permafrost-related geomorphic features including patterned ground, pingos, thaw lakes, beaded drainage, thaw or thermokarst pits, and muck deposits. Known permafrost thickness ranges from about 1,300 ft near Barrow in northern Alaska to less than a foot at the southern margin of the permafrost region. The distribution of permafrost is controlled by climatic, geologic, hydrologic, topographic, and botanic factors. The extensive permafrost region of Alaska poses special engineering problems for the design, construction, and maintenance of all types of structures. Lack of knowledge about permafrost has resulted in tremendous maintenance costs and even in relocation or abandonment of highways, railroads, and other structures. Because of the unique geologic-environmental conditions that exist in permafrost areas, special engineering procedures should be used, not only to minimize disruption of the natural environment, but also to provide the most economical and sound methods for developing the natural resources of the permafrost region of Alaska. (Knapp-USGS) W69-10106

INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR,
State Hydrological Inst., Leningrad (USSR). For primary bibliographic entry see Field 02A. W69-10132

VELOCITY OF COMPRESSIVE WAVES IN POROUS MEDIA AT PERMAFROST TEMPERATURES,

Chevron Research Co., La Habra, Calif.

A. Timur.

Geophysics, Vol 33, No 4, p 584-595, Aug 1968. 12 p, 6 fig, 2 tab, 17 ref.

Descriptors: *Seismic properties, *Permafrost, *Seismic studies, *Elasticity (Mechanical), Porous media, Sound waves, Seismology, Frozen ground, Frozen soils, Cold regions, Surveys, Ice, Freezing, Soil mechanics, Porosity, Sandstones, Shales.

Identifiers: *Compressional wave velocity (Permafrost), Elastic wave propagation.

Measurements of velocity of compressional waves in consolidated porous media, conducted within a temperature range of 26 deg C to -36 deg C, indicate that: (1) compressional wave velocity in water-saturated rocks increases with decreasing temperature whereas it is nearly independent of temperature in dry rocks; (2) the shapes of the velocity versus temperature curves are functions of lithology, pore structure, and the nature of the interstitial fluids. As a saturated rock sample is cooled below 0 deg C, the liquid in pore spaces with smaller surface-to-volume ratios (larger pores) begins to freeze and the liquid salinity controls the freezing process. As the temperature is decreased further, a point is reached where the surface-to-volume ratio in the remaining pore spaces is large enough to affect the freezing process, which is completed at the cryohydric temperature of the salt-water system. In the ice-liquid-rock matrix system, present during freezing, in a 3 phase, time-average equation may be used to estimate the compressional wave velocities. Below the cryohydric temperature, elastic wave propagation takes place in a solid-solid system consisting of ice and rock matrix. In this frozen state, the compressional wave velocity remains constant, has its maximum value, and may be estimated through use of the two-phase time average equation. Limited field data for compressional wave velocities in permafrost indicate that pore spaces in permafrost contain not only liquid and ice, but also gas. Therefore, before attempting to make velocity estimates through the time-average equations, the natures and percentages of pore saturants should be investigated. (Knapp-USGS) W69-10138

INVESTIGATION OF A METHOD OF MEASURING SNOW STORAGE BY USING THE GAMMA RADIATION OF THE EARTH,

State Hydrological Inst., Leningrad (USSR).

N. V. Zotimov.

Transl from Trudy GGI, No 152, 1968, p 114-130. Soviet Hydrol Selec Pap No 3, p 254-265, 1968. 12 p, 10 tab, 6 fig, 6 ref.

Descriptors: *Snow surveys, *Water equivalent, *Instrumentation, *Nuclear meters, Snow cover, Snow packs, Water yield, Snow, Runoff, Nuclear moisture meters, Radioactivity, Moisture content.

Identifiers: Gamma-ray snow meters, Soil radioactivity.

Analysis of the method of measuring the water equivalent of snow using the natural radioactivity of the earth and the results of field tests showed that the use of the radioelectronic snow gage for this purpose under stable snow cover conditions is fully justified. Under these conditions, the errors in the measurement of snow storage with the M-100 instrument do not exceed 2.58 mm for a snow storage between 10 and 300 mm. The errors in the measurement of the water equivalent of snow increase for an unstable snow cover because of considerable variations in the moisture content of soil in the layer from 0 to 20 cm. The efficiency of snow measurements is 5-6 times higher than that by the weighing method, and determination of the water equivalent of snow is much less laborious, particularly in the presence of a frozen snow crust or ice crust. (Knapp-USGS) W69-10142

2D. Evaporation and Transpiration

INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR,

State Hydrological Inst., Leningrad (USSR).

P. P. Kuz'min, L. I. Zubenok, A. R. Konstantinov,

N. I. Astakhova, and V. V. Vinogradov.

Transl from Trudy GGI, No 151, 1968, p 5-11. Soviet Hydrol, Selec Pap No 3, p 201-206, 1968. 6 p, 1 fig, 2 tab, 4 ref.

Descriptors: *Evaporation, *Evapotranspiration, Humidity, Water balance, Statistical methods, Climatology, Energy budget, Meteorology, Soil moisture, Plants, Vegetation effects.

Identifiers: *USSR.

Evapotranspiration was computed for 186 stations in the USSR by the water balance method and for 156 stations by a method using air temperature and humidity. The discrepancies between results of the 2 methods can be considerable. The results of the calculations are summarized and tabulated by months, geographic regions, and types of vegetation. (Knapp-USGS) W69-09920

DETERMINATION OF THE SEASONAL AND MONTHLY EVAPORATION NORMALS FROM AGRICULTURAL FIELDS FROM OBSERVATIONS AT A NETWORK OF STATIONS,

State Hydrological Inst., Leningrad (USSR).

P. P. Kuz'min, S. F. Fedorov, and B. A. Pomytkin.

Transl from Trudy GGI, No 151, 1968 p 12-29. Soviet Hydrol, Selec Pap No 3, p 206-221, 1968. 16 p, 3 fig, 19 ref, 5 append.

Descriptors: *Evaporation, *Evapotranspiration, Humidity, Climatology, Energy budget, Meteorology, Soil moisture, Plants, Crops, Vegetation effects.

Identifiers: *USSR.

A method is given for determining long-period average seasonal and monthly evaporation from agricultural fields during the warm period, May-September. The method uses an empirical graphic relationship between crop evaporation coefficient and the radiational aridity index. Calculations of evaporation are tabulated and compared with evaporation measurements in all the major geographic regions of the USSR. (Knapp-USGS) W69-09921

EFFECT OF DYE ON SOLAR EVAPORATION OF BRINE,

New Mexico State Univ., University Park. Dept. of Civil Engineering.

C. G. Keyes, Jr., and N. N. Gunaji.

OSW Contract No 14-01-001-511. Invest supported by contract with Office of Saline Water. Symp on Geochem, Precipitation, Evaporation, Soil-Moisture, Hydrom, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Publ No 78, p 338-347, 1968. 10 p, 2 fig, 3 tab, 18 ref.

Descriptors: *Evaporation, *Waste disposal, *Brines, Hydrologic budget, Heat budget, Energy budget, Water temperature, Color, Solar radiation, Heated water, Absorption.

Identifiers: Dyes, Heat absorbing dyes.

Studies were made of the effect of dyes on solar evaporation of brine at the Roswell Saline Water Conversion Plant Effluent Ponds, near Roswell, New Mexico. This program, initiated in the spring of 1965, observed the effect of Methylene Blue, Congo Red, Nigrosine, Bismark Brown, and 2-Naphthol Green dyes on solar evaporation of brine. To evaluate the efficiencies of increases evaporation and the economic feasibility of the addition of dyes, evaporation must be determined accurately. The energy budget and water budget methods for evaluating the effect of dye on the solar evaporation of brine in Modified Cummings Radiation Integrators are discussed. The addition of Methylene Blue dye affected the short-wave reflectivity, Bowen's Ratio, and the evaporated depth. The ad-

Streamflow and Runoff—Group 2E

dition of Congo Red dye affected the surface temperature and the Bowen's Ratio of the brine. The study shows that the Water Budget Method for determining evaporated depth in a Modified Cummins Radiation Integrator is more reliable than the Energy-budget Method. The calculations of evaporated depth by this method support the hypothesis that the Methylene Blue dye will increase the solar evaporation of brine while the Congo Red dye has little or no effect on the evaporation of brine. (Knapp-USGS) W69-09923

COMPUTER TECHNOLOGY IN EVAPORATION STUDIES.

New Mexico State Univ., University Park. Dept. of Civil Engineering; and New Mexico State Univ., University Park. Engineering Experiment Station. C. G. Keyes, Jr., and N. N. Gunaji.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Vol 2, Int Ass Sci Hydrol, Publ No 81, p 650-660, 1968. 11 p, 3 fig, 28 ref.

Descriptors: *Evaporation, *Data processing, *Digital computers, Mass transfer, Energy budget, Hydrologic budget, Statistical methods, Surveys, Data collections, Data storage and retrieval. Identifiers: Evaporation data reduction.

The energy budget, mass transfer, and water budget methods were used to evaluate evaporation suppression techniques and the effects of dyes on the solar evaporation of brines. Most of the 9 terms in the energy budget equation were recorded on 12-channel potentiometric multipoint recorders. Mean values of each of the terms, which could include one or more variables, were obtained over a thermal survey period of at least 7 days. These mean values were arrived at by first dividing each thermal survey period into subperiod time with an Amsler Integrator, and then using the digital computer to obtain the mean values of each term for each thermal survey period. A computerized probable error analysis was run on the results and on each term of all the methods in conjunction with each method. This statistical analysis showed that the Water Budget Method was the most reliable of the 3 methods used. Although the normal Mass Transfer Method of determining evaporation is relatively simple, most mass transfer coefficients do not produce adequate results for an area. Therefore, new quasi empirical Mass Transfer formulas were developed by using a least squares program fit to the periodical data. The new Mass Transfer coefficients apply to 2 areas which are approximately 200 mi apart. (Knapp-USGS) W69-09930

EVAPORATION INVESTIGATIONS AT ELEPHANT BUTTE RESERVOIR IN NEW MEXICO.

New Mexico State Univ., University Park. Engineering Experiment Station.

Narendra N. Gunaji.

Symp on Geochem, Precipitation, Evaporation, Soil-Moisture, Hydrom, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Publ No 78, p 308-325. 18 p, 1 fig, 4 tab, 9 ref.

Descriptors: *Evaporation, *Reservoir evaporation, *New Mexico, Rio Grande, Climatology, Energy budget, Mass transfer, Evaporation control, Meteorology, Arid lands. Identifiers: *Elephant Butte Reservoir (N Mex).

Water losses by evaporation were studied at Elephant Butte Reservoir, near Truth or Consequences, New Mexico. Evaporation suppression investigations require the determination of evaporation as accurately as possible to evaluate the efficiencies of evaporation savings and the economic feasibility of suppression. The determination of evaporation at this Rio Grande site is important not only for suppression studies to follow, but also for the growing problems involving interstate and international water rights and the reliabil-

bilities and assurances of domestic water delivery. Water losses by evaporation from Elephant Butte Reservoir were determined utilizing the energy-budget technique. The Cummings Radiation Integrator (CRI) was tested as an effective means for measuring net incoming radiation. The coefficient N in the quasi-empirical mass-transfer equation of evaporation was determined using the energy-budget method as a control. The coefficient K in the heat-transfer equation of energy convected to or from the reservoirs surface was evaluated. The significance of errors in data analysis in evaporation studies was determined. (Knapp-USGS) W69-09934

MODIFICATIONS AND EVALUATING OF THE EVAPOTRANSPIRATION TENT.

Forest Service (USDA) Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. Arnett C. Mace, Jr., and J. R. Thompson.

USDA Forest Serv Res Paper RM-50, 1969. 16 p.

Descriptors: *Evapotranspiration, *Measuring instruments, *Evaluation. Identifiers: *ET tent.

Evidence indicates that reduced ventilation rate is the principal cause of heat buildup inside the original plastic evapotranspiration tent. After the tent was modified to increase wind movement, data indicated no significant increase in air temperature within the enclosure as long as it was fully occupied by vegetation. Future modification should include a variable tent size and improved air-flow measurements. (Thompson-Forest Service) W69-09984

DEVELOPED EQUATION OF THE WATER BALANCE (POLISH).

For primary bibliographic entry see Field 02A. W69-10108

ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES, 1967.

Bureau of Reclamation, Denver, Colo.

For primary bibliographic entry see Field 03B. W69-10126

COMPARATIVE ESTIMATE OF METHODS OF COMPUTING EVAPORATION FROM BODIES OF WATER.

State Hydrological Inst., Leningrad (USSR).

V. I. Kuznetsov, and T. G. Fedorova.

Transl from Trudy GGI, No 152, 1968, p 94-113. Soviet Hydrol Selec Pap No 3, p 239-253, 1968. 15 p, 14 tab, 5 fig, 8 ref, 2 append.

Descriptors: *Evaporation, *Reservoir evaporation, *Evaluation, Humidity, Winds, Evaporation pans, Lakes, Energy budget, Water balance, Temperature, Vapor pressure, Forecasting. Identifiers: *USSR.

Methods of forecasting evaporation from bodies of water developed and used in the USSR are compared and evaluated. Computed evaporation values were compared with observations using floating evaporation pans. Results are tabulated and summarized. The most accurate method was based on use of vapor pressure and wind velocity data, using formulas by Zaykov, Braslavskiy and Vikulina. (Knapp-USGS) W69-10131

WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER.

Agricultural Research Service, Riverside, Calif.

Salinity Lab.

S. L. Rawlins, R. S. Austin, E. M. Cullen, W. N. Herkebrath, and G. J. Hoffman.

US Army Electron Command Atmos Sci Lab Tech Rep ECOM 2-68-F, Dec 1968. 137 p, 41 fig, 6 tab, 51 ref.

Descriptors: *Evapotranspiration, *Instrumentation, Water quality, Water balance, Transpiration, Evaporation, Lysimeters, Soil water movement, Solar radiation, Temperature, Stomata. Identifiers: Psychrometers.

Independent measurements of matric and osmotic potential show that the osmotic potential of a NaCl solution is significantly lowered by interaction with the soil matrix. This is explained by salt exclusion from the zone near soil particle surfaces. Advances in technology for measurement of water potential include a thermocouple for direct attachment to plant leaves, a device for automatic cycling and recording of outputs from Peltier thermocouple psychrometers, detailed instructions and illustrations for assembly of thermocouple psychrometers and a multiple temperature water bath. A microchamber for studying plant responses to environment is described. In it, light intensity and duration, ambient temperature, relative humidity, and carbon dioxide concentration are controlled, and transpiration, carbon dioxide assimilation, and plant and soil water potential are measured. Data for the ratio of transpiration to carbon dioxide assimilation for cotton are given. Moderate salinity increased this ratio. Preliminary results from experiments to determine how plants integrate time varying salinity indicate that transpiration per unit leaf area is decreased by salinity. (Knapp-USGS) W69-10136

DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE, State Hydrological Inst., Leningrad (USSR). For primary bibliographic entry see Field 07B. W69-10140

2E. Streamflow and Runoff

DISPERSION OF FLOATING PARTICLES IN UNIFORM CHANNEL FLOW, Technical Univ. of Denmark, Copenhagen. For primary bibliographic entry see Field 02J. W69-09887

LONGITUDINAL DISPERSION IN OPEN CHANNELS.

Pittsburgh Univ., Pa.

Attila A. Sooki.

ASCE Proc, J Hydraul Div, Vol 95, No HY 4, Pap 6697, p 1327-1346, July 1969. 20 p, 5 fig, 28 ref, 3 append.

Descriptors: *Dispersion, *Open channel flow, Turbulent flow, Steady flow, Mixing, Diffusion, Streamflow, Water pollution treatment. Identifiers: Longitudinal dispersion.

The effects of cross-sectional geometry and velocity distribution on the dispersion process in straight, uniform open channels with large width-to-depth ratio are investigated. The method of investigation follows Taylor's approach and thus the results apply after the elapse of an initial period during which a constant dispersion coefficient has developed. Under the assumed conditions the longitudinal dispersion coefficient can be described by a general expression in which the hydraulic radius and the shear velocity are variables. Dispersion varies significantly with cross-sectional shape, width-to-hydraulic radius ratio, and the Reynolds number. The calculated values and pattern of variation are compared to available data for open channels with irregular cross section. (Knapp-USGS) W69-09888

RESISTANCE TO REVERSING FLOWS OVER MOBILE BEDS, Technical Univ. of Istanbul (Turkey). M. Bayazit.

ASCE Proc, J Hydraul Div, Vol 95, No HY 4, Pap 6649, p 1109-1127, July 1969. 19 p, 17 fig, 12 ref, 2 append.

Field 02—WATER CYCLE

Group 2E—Streamflow and Runoff

Descriptors: *Bed load, *Alluvial channels, *Tides, *Currents (Water), Waves (Water), Channel morphology, Ripple marks, Regime, Roughness (Hydraulic), Model studies, Hydraulic models, Sedimentation, Sediment transport.

Identifiers: Reversing flow.

Configuration of a movable bed changes periodically as the velocity of the reversing flow over it varies in time. Experiments are carried out with bed materials of various densities. Ripples generated on the bed surface are essentially similar to those of unidirectional flow, but their shapes are reversed as to conform with the flow direction. The resistance of such a bed depends on grain Froude number and grain Reynolds number. The importance of viscosity in determining the resistance is emphasized. The resistance function at the instant of peak velocity is determined for the conditions of movable-bed tidal models. Ripple friction factor is found not to depend on the depth and the period of the flow in the ranges used in the experiments. Relationships determining the resistance of a movable bed for tidal model conditions are presented. (Knapp-USGS)
W69-09892

FRICITION-FACTORS FOR FLAT-BED FLOWS IN SAND CHANNELS,

Iowa Univ., Iowa City.

F. Lovera, and John F. Kennedy.

ASCE Proc, J Hydraul Div, Vol 95, No HY 4, Pap 6678, p 1227-1234, July 1969. 8 p, 2 fig, 1 tab, 20 ref, 2 append.

Descriptors: *Open channel flow, *Turbulent flow, *Alluvial channels, Hydraulics, Roughness (Hydraulic), Roughness coefficient, Sediment transport, Bed load, Regime, Model studies, Hydraulic models.

Identifiers: Friction factor (Hydraulic).

A method is developed for determining friction factors of open channel flows over flat sand beds in an active state of transport. The graphical predictor is derived from both field and laboratory data, and is presented in a format similar to that of the Moody pipe-friction diagram. The variation of friction factor with Reynolds number for constant values of the ratio of hydraulic radius to median sediment size was found to be much different for these flows than for one-phase flows in rigid-boundary conduits. (Knapp-USGS)
W69-09893

BASIC DATA REPORT NO 3 FOR RESEARCH ON FLOOD FREQUENCY FOR SMALL DRAINAGE AREAS,

Geological Survey, Jackson, Miss.

James W. Hudson.

Geol Surv Open-file Rep, June 1969. 102 p, 2 fig, 3 ref, append.

Descriptors: *Floods, *Small watersheds, *Mississippi, *Data collections, *Hydrologic data, Peak discharges, Stage-discharge relations, Gaging stations.

Identifiers: Mississippi flood data.

Small drainage basin flood frequency data for Mississippi are summarized and tabulated. Peak stages and discharges recorded through March 1968 are included. Each record includes station number, location, gage history, basin parameters, type of flow, and a table of stages and discharges. (Knapp-USGS)
W69-09895

FLOODPLAIN INFORMATION, FIVE MILE CREEK, METROPOLITAN BIRMINGHAM, ALABAMA.

Corps of Engineers, Mobile, Ala.

For primary bibliographic entry see Field 04A.
W69-09896

FLOODPLAIN INFORMATION, SWEETWATER, JACKSON, CAMP, BEAVER RUN, AND BROMOLOW CREEKS, METROPOLITAN ATLANTA, GEORGIA.

Corps of Engineers, Savannah, Ga.

For primary bibliographic entry see Field 04A.
W69-09897

FLOODPLAIN INFORMATION, FOURCHE CREEK AND TRIBUTARIES, LITTLE ROCK, ARKANSAS - PART 1.

Corps of Engineers, Little Rock, Ark.

For primary bibliographic entry see Field 04A.
W69-09898

DISCHARGE MEASUREMENT IN OPEN CHANNELS BY DILUTION METHODS (FRENCH),

Liege Univ. (Belgium).

For primary bibliographic entry see Field 07B.
W69-09905

TOTAL RUNOFF TRAVEL TIME DURING THE FORMATION OF MIXED 'SURFACE-SUBSURFACE' RAIN FLOODS IN SMALL WATER COURSES,

State Hydrological Inst., Leningrad (USSR).

For primary bibliographic entry see Field 02A.
W69-09915

NUMERICAL SIMULATION OF WAVE-CREST MOVEMENT IN RIVERS AND ESTUARIES,

Geological Survey, Washington, D.C.

Chintu Lai.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Vol 2, Int Ass Sci Hydrol, Publ No 81, p 699-713, 1968. 15 p, 6 fig, 2 tab, 9 ref.

Descriptors: *Model studies, *Computer models, *Digital computers, *Synthetic hydrology, Estuaries, Rivers, Waves (Water), Floods, Routing, Tides, Streamflow, Numerical analysis, Open channel flow, Unsteady flow.

Identifiers: Method of characteristics, Implicit method.

The set of partial differential equations describing unsteady flow in an open channel can be solved numerically by using appropriate mathematical methods for digital computers, such as the method of characteristics or the implicit method. Computer programs have been written for the application of such mathematical methods to a large number of water elements so that the wave-crest movement in the waterway can be numerically simulated. By taking a sufficiently large number of water elements and sufficiently small time intervals, it is possible to obtain a series of realistic, illustrative, and continuous pictures with appropriate computer peripheral equipment. Such pictorial or graphical outputs from the digital computer may be in the form of line-printer outputs, X-Y plotter drawings, cathode-ray tube displays, or movie-film exposition. Two examples from surface water hydrology problems, one for the flood wave movement in a river, the other for the tidal wave movement in an estuary, indicate that this technique of so-called 'numerical experiment' affords a means to accurately and economically investigate flood or tidal flow at the prototype scale and provides many advantages over other methods. (Knapp-USGS)
W69-09919

FLOW MEASURING STRUCTURES IN THE HYDROLOGICAL OBSERVATION NETWORK,

Research Inst. for Water Resources Development, Budapest (Hungary).

O. Starosolszky.

Symp on Geochem, Precipitation, Evaporation, Soil-Moisture, Hydrom, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Publ No 78, p 384-394, 1968. 11 p, 8 fig, 3 ref.

Descriptors: *Stream gages, *Equipment, Flumes, Weirs, Instrumentation, Depth, Discharge (Water), Flow rates, Hydrographs, Gaging stations, Stage-discharge relations, Streamflow, Networks.

Identifiers: *Hungary.

In order to stabilize the relationship between stages and discharges in small watercourses and canals, special gaging structures are necessary for continuous discharge recording. During the last 10 yr some 60 different gaging structures have been designed and constructed in Hungary. The mean error of discharge measurement can be calculated on the basis of the mean error of function values. To limit error in discharge measurement, the minimum heads at gages must be specified. In order to eliminate the effect of channel changes, special gaging structures were developed. The relative mean error of flow volume can be found by interpreting duration curves. Methods are suggested for estimating the error in flow volume due to the neglect of submergence. In order to avoid errors, favorable flow conditions must be secured by design of measuring structures, the major dimensions must be adjusted to an accuracy of a few mm and submergence should be allowed but rarely. The hydrologist utilizing these data should be well-informed on the reliability of his measurement. (Knapp-USGS)
W69-09929

HYDROLOGIC DISTRIBUTIONS RESULTING FROM MIXED POPULATIONS AND THEIR COMPUTER SIMULATION,

Illinois State Water Survey, Urbana.

For primary bibliographic entry see Field 07C.
W69-09935

RIVERS AND LAKES OF THE MONGOLIAN PEOPLE'S REPUBLIC (RUSSIAN),

Gidrometeorologicheskii Institut, Leningrad (USSR).

V. L. Shul'ts.

Trudy Nauch-Issled Gidrometeorol Inst, Leningrad, USSR, Issue No 37 (52), 1967. 22 p, 6 fig, 3 tab, 8 ref.

Descriptors: *Rivers, *Lakes, *Physical properties, Pressure, Permafrost, Hydrologic aspects, Glaciers, Climates, Precipitation (Atmospheric), Air temperature, Rain, Water sources, Snowmelt, Aquifers, Runoff, Water resources, Hydrographs, Salinity.

Identifiers: *USSR, Mongolian People's Republic, Outer Mongolia.

A monograph discusses in a very general manner the rivers and lakes of the Mongolian People's Republic on the basis of earlier publications and author's recent hydrogeological research. The book contains the following chapters: (1) natural conditions; (2) Mongolian mountains; (3) climate; (4) rivers; (5) water sources; (6) annual runoff variations; (7) annual runoff distribution, (8) total annual resources; (9) description of the principal rivers; and (10) lakes. (Gabriel-USGS)
W69-09941

STREAMFLOW RECORDS FROM THE SAN DIMAS EXPERIMENTAL FOREST, 1939-1959,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.

J. S. Krammes, J. D. Lent, and J. W. Clarke.

US Forest Serv Res Note PSW-79, Pacific SW, Forest and Range Exp Sta, Berkeley, Calif, 1965. 10 p, illus.

Descriptors: *Hydrographs, *Hydrologic data, *Chaparral, Hydrology, Streams, Data collections, Demonstration watersheds, California, Watersheds (Basins), Discharge (Water).

Identifiers: Southern California, Experimental watersheds.

Summarizes hydrographs covering 314 station-years of record. Mean daily streamflow tables,

Streamflow and Runoff—Group 2E

flood peak tables, and supplemental watershed data are on microfilm, which is available upon request. (Krammes-Forest Service) W69-09990

SELECTED URBAN STORM WATER RUNOFF ABSTRACTS.

Franklin Inst. Research Labs., Philadelphia, Pa. Science Information Services. For primary bibliographic entry see Field 04C. W69-10085

FLOOD PLAIN INFORMATION, MISSISSIPPI RIVER AT NATCHEZ, MISSISSIPPI. Corps of Engineers, Vicksburg, Miss.

For primary bibliographic entry see Field 04A. W69-10086

FLOODS OF JANUARY AND FEBRUARY 1969 IN CENTRAL AND SOUTHERN CALIFORNIA, Geological Survey, Menlo Park, Calif.

A. O. Waananen. Geol Surv Open-file Rep, May 20, 1969. 233 p, 28 fig, 1 photo, 7 tab.

Descriptors: *Floods, *California, *Data collections, *Hydrologic data, Streamflow, Stage-discharge relations, Water levels, Surface waters, Hydrographs, Rainfall, Disasters, Discharge (Water). Identifiers: Central and Southern California floods.

Floods of unprecedented magnitude in late January and late February 1969 created havoc in the Santa Clara River and Santa Ynez River basins, California, and record-breaking floods occurred in many other basins. The floods resulted from a series of storms in January and February, notably the heavy rains of Jan 18-22, 24-27, and Feb 22-25. Rain was particularly heavy in the San Bernardino, San Gabriel, Santa Monica, and Santa Ynez Mountains, and in southern Sierra Nevada. Maximum precipitation of 33 in. was observed Jan 24-27 at Mount Baldy Notch in the San Gabriel Mountains; the total precipitation for January and February at this station was nearly 85 in. The peak discharge of 165,000 cfs Jan 25 in Santa Clara River at Saticoy and 100,000 cfs in Santa Ynez River near Lompoc far exceeded the previous maximum flows of record. The suspended-sediment concentration and discharge observed in several streams greatly exceeded any previously observed. The maximum concentration observed was 75,000 mg/l in Santa Clara River at Saticoy, but peak concentration was estimated to be as high as 160,000 mg/l. An estimated load of more than 150,000 tons of dissolved solids was discharged to the sea Jan 18-31 by the Santa Clara River. Groundwater levels showed substantial rises following the floods as a result of percolation of storm runoff and floodflows, notably in alluvial-fan areas such as the foothills of the San Gabriel Mountains. (Knapp-USGS) W69-10089

GEOLOGIC CONTROL OF RAINFALL-RUNOFF RELATIONS IN THE PEAK CREEK WATERSHED, PULASKI AND WYTHE COUNTIES, VIRGINIA,

Virginia Polytechnic Inst., Blacksburg. Dept. of Geological Science. For primary bibliographic entry see Field 02A. W69-10090

VISCOSITY DISSIPATION IN EXTERNAL NATURAL CONVECTION FLOWS, Cornell Univ., Ithaca, N.Y.

For primary bibliographic entry see Field 01A. W69-10091

SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958-SEPT 1967), Geological Survey, Minneapolis, Minn.

Lowell C. Guetzlow, and George H. Carlson.

Geol Surv Open-file Rep, Apr 1969. 174 p, 15 fig, 1 tab.

Descriptors: *Floods, *Data collections, *Small watersheds, *Minnesota, Streamflow, Hydrographs, Gaging stations, Flow characteristics, Stage-discharge relations, Peak discharge. Identifiers: *Crest-stage stations, Flood peak, Flood measurements.

An investigation of flood flows from small drainage basins in Minnesota was initiated to aid in the design of bridges, culverts and other highway drainage structures. The program provides peak flow data on streams having drainage areas generally less than 50 sq mi, placing particular emphasis on those less than 10 sq mi. Published data, when supplemented by some additional years of flood record, are the basis for a statewide flood frequency study. Basin parameters being investigated for their effect on floods are drainage area, length of main stream, slope of main stream, stream density, relief ratio, basin shape, and vegetal cover. Each of the 144 gaging stations included in the report are equipped with crest-stage gages, and 10 stations have continuous recorded records of stage and precipitation. Hydrographs of significant flood events are presented for most recording stations. The relative magnitude of flood flows for different hydrologic regions are shown in graphs which relate maximum discharge to drainage area size. Each station record contains location, drainage area, records available, type of gage, on-site structure elevations, bankfull stage, and annual maximum stage and discharge data. (Lang-USGS) W69-10093

WATER RESOURCES OF THE JOPLIN AREA, MISSOURI,

Geological Survey, Rolla, Mo. Water Resources Div.

For primary bibliographic entry see Field 02F. W69-10095

IDENTIFICATION OF SPECTRAL CHARACTERISTICS OF HYDROLOGICAL SERIES BY A MODIFICATION OF THE GRENADE-ROSSENBLATT METHOD (RUSSIAN),

I. V. Khomeriki.

Soobsch Akad Nauk, Gruz SSR (Bull Acad Sci of Georgian SSR), Vol 53, No 3, p 661-664, Mar 1969. 4 p, 1 fig, 5 ref. English summary provided with Russian text.

Descriptors: *Runoff forecasting, *Time series analysis, *Hydrologic data, *Mathematical models, Runoff, Water pressure, Energy transfer, Statistical methods, Correlation analysis, Frequency, Discharge (Water), Hydrologic equation, Electronics, Computers.

In calculating regulating systems of river runoff 2 alternative hypothesis are considered: (a) Runoff is a random process with a periodic trend; (b) Runoff is a random process without a periodic trend. At first sight hypothesis (b) would seem to be a special case of (a). However, there is an essential difference between them. Whereas hypothesis (a) accounts for the cyclic variations of runoff by the presence of a periodic component, hypothesis (b) attributes these variations to the stationarity of the process. Spectral analysis of hydrological series enables ascertainment of the parameters of the periodic trend. This is the first attempt to use the modified method of Rossenblatt and Grenander for this purpose in hydrology. (Gabriel-USGS) W69-10096

SURFACE-WATER DISCHARGE AND GROUND-WATER LEVELS IN THE EAST FORK RIVER AREA, SUBLLETTE COUNTY, WYOMING, Geological Survey, Riverton, Wyo. D. J. O'Connell. Geol Surv Data Rep, Mar 1969. 77 p, 3 fig, 6 tab.

Descriptors: *Data collections, *Hydrologic data, *Streamflow, *Water wells, *Water levels, Water level fluctuations, Aquifers, Discharge (Water), Runoff. Identifiers: Sublette County (Wyo).

Basic data on streamflow, water quality, and water levels in wells in the East Fork River area of Sublette County, Wyoming, July 1965 to July 1968, are compiled. Drillers logs are included to show typical terrace deposit composition. (Knapp-USGS) W69-10097

INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS, Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.

For primary bibliographic entry see Field 02A. W69-10098

FLOODS OF JULY 2, 1968, IN JACKSON, MISSISSIPPI, Geological Survey, Jackson, Miss.

B. E. Wasson.

Geol Surv Open-file Rep, Jan 1969. 10 p, 4 fig.

Descriptors: *Floods, *Mississippi, *Urbanization, Hydrographs, Rainfall, Rainfall-runoff relationships, Data collections, Discharge (Water), Streamflow, Small watersheds, Isohyets, Profiles. Identifiers: *Jackson (Miss).

An urbanized belt along Woodrow Wilson Avenue in northwestern Jackson, Mississippi, received more than 4 inches of rain during a 5-hr period July 2, 1968. About 3 inches of the rain fell during 1 hr; recurrence interval of this rainfall is in excess of 10 yr. Severe flooding occurred on streams in the central part of the Town Creek basin. West Branch Town Creek at Derrick Street had the highest stage since at least 1953. The 1953 flood was much more severe than the July 2, 1968 flood, except in a small area upstream from the mouth of West Branch Town Creek. Town Creek at Gallatin Street and Lynch Creek at Valley Street had floods representing 3-yr recurrence intervals, and Eubanks Creek at Wood Dale Drive had a 2-yr recurrence interval flood. However, some of the smaller streams in the central part of the Town Creek basin had more severe floods. (Knapp-USGS) W69-10101

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN THE DISTRICT OF COLUMBIA, Corps of Engineers, Baltimore, Md. North Atlantic Div.

For primary bibliographic entry see Field 04A. W69-10102

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN MARYLAND, Corps of Engineers, Baltimore, Md. North Atlantic Div.

For primary bibliographic entry see Field 04A. W69-10103

GROUND WATER SHARE OF THE WATER BALANCE AND AN EXAMPLE OF A RIVER CATCHMENT IN THE SEASIDE REGION (POLISH),

For primary bibliographic entry see Field 02A. W69-10104

HYDROLOGY OF A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA, Geological Survey, Washington, D.C.

Michael J. Ellis, Donald G. Adolphson, and Robert E. West. Geol Surv Hydrol Invest Atlas HA-311, 1969. 5 p, 9 fig, 3 map, 6 tab, 24 ref.

Field 02—WATER CYCLE

Group 2E—Streamflow and Runoff

Descriptors: *Water resources, *Hydrogeology, *South Dakota, Surface waters, Groundwater, Water wells, Streamflow, Floods, Water levels, Water level fluctuations, Aquifers, Water quality. Identifiers: Big Sioux River (S Dak).

The water resources of the Big Sioux drainage basin, eastern South Dakota, are described in a 1-sheet hydrological atlas with an accompanying 5 p text. Bedrock geology, streamflow, and water quality are shown by maps and tabulated data. Hydrographs show water level fluctuations in 33 observation wells and summarize the discharge of the Big Sioux River. Flood frequencies are shown graphically. (Knapp-USGS)

W69-10110

DISCHARGE MEASUREMENTS AT GAGING STATIONS,

Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07B.

W69-10111

GEOCHEMICAL EVOLUTION OF OUED SAOURA (NORTHWESTERN SAHARA) WATERS (FRENCH),

Centre de Recherches sur les Zones Arides, Paris (France).

For primary bibliographic entry see Field 02K.

W69-10114

METHOD OF DETERMINING THE DISCHARGE OF TWO-LEVEL SPILLWAYS,

Sredneaziatskii Nauchno-Issledovatel'skii Institut Irrigatsii, Tashkent (USSR).

For primary bibliographic entry see Field 08B.

W69-10129

WATER RECORDS OF PUERTO RICO, 1958-63,

Geological Survey, Washington, D.C.

Frank P. Kipple.

Geol Surv Open-file Rep, 1968. 353 p, 15 fig.

Descriptors: *Data collections, *Surface waters, *Groundwater, *Puerto Rico, Streamflow, Water levels, Water quality, Stream gages, Observation wells, Rivers, Reservoirs, Stage-discharge relations, Water temperature, Sediment discharge, Hydrologic data.

Identifiers: Surface water records, Groundwater records, Water quality records, Water resources data.

The surface-water, quality-of-water, and groundwater records of Puerto Rico for calendar years 1958 through 1963 are presented. Included are records for streamflow stations, water wells, and the chemical and physical characteristics of the streams and groundwater. The location of all stations, except miscellaneous stations, is shown on maps of river basins and areas adjoining these basins. Each map is followed by the tabulation of water records in the particular basin and area shown on the map. The records were collected by the Caribbean District of the Water Resources Division, U.S. Geological Survey, in financial cooperation with several agencies of the Commonwealth of Puerto Rico. (Knapp-USGS)

W69-10134

EXPERIMENTAL PALEOHYDROLOGIC INVESTIGATIONS,

Leningrad State Univ. (USSR). Dept. of Geography.

N. I. Makkaveyev, and A. M. Kalinin.

Transl from Izvestiya Akad Nauk SSSR, Ser Geograf, No 4, 1968, p 15-22. Soviet Hydrol Selec Pap No 3, p 290-295, 1968. 6 p, 1 fig, 3 tab, 10 ref.

Descriptors: *Paleohydrology, *Alluvial channels, Streamflow, Discharge (Water), Cenozoic era, Sediment transport, Sedimentation, Runoff.

Identifiers: *USSR, Ural Mountains.

To determine the unit runoff from the southeastern slopes of the Urals during the Upper Oligocene-Early Miocene, two methods are used: (1) Comparison of recent and old fluvial forms on the basis of three indexes (slopes of longitudinal profiles, density of the drainage network, and dimensions of meanders) and determination of the ratio of the abundance of water courses responsible for the formation of these forms from empirical formulas relating the form parameters and the channel-forming water discharge; and (2) analysis of the particle-size composition of old alluvium and laboratory determination of the velocities, depth, and discharge of the stream having deposited it. There is good agreement between computations by both methods; the abundance of water in streams having deposited the old alluvium exceeded the recent water abundance by a factor of 10, which corresponds to a unit runoff between 10 and 30 liter/sec sq km. The old rivers resembled the present rivers of Kolkhida in their flow regime. (Knapp-USGS)

W69-10141

HYDROGEOLOGY OF THE UPPER CAPIBARIBE BASIN PERNAMBUCO, BRAZIL A RECONNAISSANCE IN AN AREA OF CRYSTALLINE ROCKS,

Superintendencia do Desenvolvimento do Nordeste (Brazil); and Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02F.

W69-10145

THE RECENT 5-YEAR DROUGHT ON SCITUATE WATERSHED AND NEARBY DRAINAGE BASINS IN RHODE ISLAND AND MASSACHUSETTS,

Water Supply Board, Providence, R.I.

Philip J. Holton, Jr.

New England Water Works Association, Vol 83, No 2, p 79-100, June 1969. 22 p, 9 tab.

Descriptors: *Droughts, *Runoff, *Precipitation (Atmospheric), *Water yield, Watersheds (Basins).

Identifiers: *Scituate Watershed in Rhode Island.

This paper examines the five year drought during the period: October 1961 to September 1966. First, the departure from the long term average of rainfall for this five year period is examined in the Scituate and Abbott Run Watersheds, and the Wachusett and Sudbury Watersheds. Then, runoff data in the Scituate Watershed, the Wachusett Watershed, and the Sudbury Watershed are investigated. Next, a comparison of runoff data is made between these three watersheds. The daily yields of all the watersheds are investigated. The final section is a discussion of the data and its relationship to drought given by Ralph M. Soule. (Grossman-Rutgers)

W69-10188

COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,

Wyoming State Engineer's Office, Cheyenne.

For primary bibliographic entry see Field 07A.

W69-10213

2F. Groundwater

IRMAY'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE,

Geological Survey, Washington, D.C.; Geological Survey, Denver, Colo.; and Bureau of Mines, San Francisco, Calif.

G. E. Manger, R. A. Cadigan, and G. L. Gates.

J Sediment Petroil, Vol 39, No 1, p 12-17, Mar 1969. 6 p, 2 fig, 3 tab, 15 ref.

Descriptors: *Aquifers, *Saturation, *Porosity, *Permeability, *Sandstones, Geology, Capillary

water, Acidic water, Igneous rocks, Mathematical studies, Sediments, Gases, Air circulation, Water circulation.

Identifiers: *Saturation factor, Fractional saturation.

The permeability of moderately permeable Jurassic sandstone from the Colorado Plateau as calculated from grain size and other textural parameters agrees reasonably well with that determined experimentally, if calculated permeability is reduced by a factor that reflects fractional saturation with capillary water. This result tends to confirm a conclusion by Irmay that in saturated permeable media a fraction of pore water is shut off from flow of water. Applicability of a saturation factor to poorly permeable sandstone is obscured where acid-soluble contents are high; apparent inapplicability results at very fine grain size perhaps because calculated permeability is not valid where based on very fine grain diameter. (Gabriel-USGS)

W69-09909

GROUNDWATER IN OGALLALA FORMATION IN THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO,

Geological Survey, Washington, D.C.

James G. Cronin.

Geol Surv Hydrol Invest Atlas HA-330, 1969. Text, 4 map, 1 tab, 25 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Texas, *Groundwater mining, New Mexico, Water supply, Irrigation water, Water levels, Water level fluctuations, Water utilization, Water yield, Water quality, Water wells.

Identifiers: Southern High Plains (Tex-N Mex), Ogallala Formation.

A 4-sheet hydrological atlas shows the current information about the Ogallala aquifer in the Southern High Plains of Texas and New Mexico. Maps scaled 1:500,000 show the saturated thickness of the Ogallala Formation, the altitude of its base, water table altitude, and water level decline since the beginning of heavy pumping for irrigation. A short text included with the maps discusses location and development of the report area, high plains hydrogeology, water quality, and outlook for future water supplies. (Knapp-USGS)

W69-09913

GRAVIMETRIC ESTIMATION OF DEPTH TO AQUIFERS IN THE HAZEVA AREA, ARAVA VALLEY, ISRAEL,

P. R. May.

Israel J Earth-Sci, Vol 17, No 1, p 30-43, Jan 1968. 14 p, 7 fig, 5 ref.

Descriptors: *Groundwater, *Surveys, *Geophysics, *Gravimetry, Gravimeters, Gravity, Gravity studies, Gravimetric analysis, Density, Aquifers, Artesian wells, Limestones, Faults (Geology).

Identifiers: *Israel, Hazeva area, Arava Valley.

Aquifers in the Judea limestone extend from outcrops on the Negev uplands into the Hazeva area in the Arava Valley, Israel and form a continuous artesian system eastward to the western border fault of the Dead Sea graben. A gravity survey shows that the Hazeva area is part of a shallow intermontane basin in which the Judea limestone lies at depths of from less than 100 m in the southwest to 450 m on the east along the border fault of the Dead Sea graben. Within the graben the Judea limestone lies at depths of greater than 1000 m. Between coordinate 018 and 031 north, the western border fault extends approximately north-south along coordinate 117 east, and is mostly concealed beneath Tertiary and Quaternary sediments. On the northwest the Hazeva basin is bounded by a vertical or high-angle thrust fault, and on the southwest by the unfaulited uplift of the Shezaf dome. Depth estimations are made at six localities along the bounding faults by direct computation of the parameters of the fault anomaly, namely, the

total anomaly caused by the fault, and the maximum residual gradient. The principal density interface in the geologic column occurs at the top of the Judea limestone. The density contrast between the Judea limestone and overlying rocks was determined from outcrops to be 0.5 gm/cu cm. This contrast is assumed to be uniform throughout the area. (Knapp-USGS)
W69-09917

URANIUM DISEQUILIBRIUM IN GROUND-WATER: AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS,
Florida State Univ., Tallahassee. Dept. of Geology.
For primary bibliographic entry see Field 02K.
W69-09925

TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA: 2, FINITE RESERVOIRS,
Texas Univ., Austin.
For primary bibliographic entry see Field 08E.
W69-09926

ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION,
Texas Univ., Austin.
For primary bibliographic entry see Field 08E.
W69-09927

COMPARISON BETWEEN ANALOG AND DIGITAL SIMULATION TECHNIQUES FOR AQUIFER EVALUATION,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 07C.
W69-09931

GROUND-WATER RESOURCES OF ESSEX COUNTY, NEW JERSEY,
Geological Survey, Trenton, N.J.
William D. Nichols.

NJ Dep Conserv and Econ Develop, Div of Water Spec Rep No 28, 1968. 56 p, 13 fig, 3 tab, 15 ref.

Descriptors: *Water resources, *Groundwater, *New Jersey, Water wells, Aquifers, Water yield, Water quality, Hydrologic data, Data collections, Water levels, Water sources.
Identifiers: *Essex County (NJ).

Groundwater in Essex County, New Jersey occurs in joints and fractures in consolidated rocks and in porous unconsolidated stratified drift deposits. Wells in sandstone and shale of the Brunswick Formation of Triassic age yield from 35 to 820 gpm; the most productive water-bearing zones are commonly between depths of 300 to 400 ft. Wells in the Watchung basalt, which is intercalated with rocks of the Brunswick Formation, commonly yield small to moderate supplies but may occasionally yield up to 400 gpm. Large yields, ranging from 410 to 1,593 gpm, are common from wells tapping the stratified drift deposits in the western part of the county. Quality of groundwater is acceptable for most uses throughout the county. However, heavy pumping in the Newark area has lowered water levels to more than 100 ft below sea level and has reversed the natural gradient and induced saline water intrusion. The chloride concentration in the aquifer has increased since 1951. Highly productive stratified drift deposits are found primarily west of Second Watchung Mountain. Withdrawals of groundwater for public supply averaged about 26 mgd in 1966. Pumpage for public supply from aquifers in unconsolidated sediments averaged 20.9 mgd. Most of the productive aquifers in Essex County are currently being developed. (Knapp-USGS)
W69-09933

USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW PROBLEMS IN AQUIFER SYSTEMS,
California Univ., Berkeley.

For primary bibliographic entry see Field 07C.
W69-09937

THE AVAILABILITY OF GROUNDWATER FROM THE POTOMAC FORMATION IN THE CHESAPEAKE AND DELAWARE CANAL AREA, DELAWARE,
R. W. Sundstrom.
Del Univ Water Resources Center Rep, June 1967. 95 p, 19 fig, 18 tab, 41 ref. OWRR Proj A-006-ARK.

Descriptors: *Water resources, *Groundwater, *Surveys, *Delaware, Aquifers, Water wells, Water yield, Water quality, Saline water intrusion, Water levels, Groundwater movement, Hydrogeology, Hydrologic data, Data collections.
Identifiers: Chesapeake and Delaware Canal.

The availability of groundwater from the Potomac Formation in the Chesapeake and Delaware Canal area in Delaware was appraised and a family of two drawdown curves was developed. These curves, one for the upper aquifer and one for the lower aquifer of the Potomac, were constructed on the basis of the actual average pumpage from the 2 aquifers by the Tidewater Oil Company during the last several years. Several hypothetical plans of pumping centers, yielding as much as 11 mgd in the Canal area are demonstrated. The drawdown curves presented were developed on the premise that the overall hydrology that applies to Tidewater also applies to other centers of pumping throughout the Canal area. There appears to be no danger of salt water contamination in the reasonably foreseeable future. In the western section of the Canal area in Delaware the Magothy Formation, which is overlain by Pleistocene sands and underlain by the Potomac, crops out in the Canal. The Canal at times contains relatively saline water. The Pleistocene and Magothy in this locality now are protected by the hydraulic gradient toward the Canal. Some contamination might occur to the upper Potomac in this location if the hydraulic gradient were reversed. (Knapp-USGS)
W69-09942

GROUNDWATER RESOURCES OF PAMPANGA PROVINCE,
Philippines Dept. of Public Works and Communications, Manila. Bureau of Public Works.
A. S. Manalac.
Philippines Repub Bur Public Works Groundwater Pap No 1, 1959. 117 p, 12 fig, 2 tab, 10 ref, 7 append.

Descriptors: *Water resources, *Groundwater, *Aquifers, Water yield, Water quality, Water wells, Groundwater movement, Hydrologic data, Data collections, Hydrogeology.
Identifiers: Philippines, Pampanga province.

The Province of Pampanga, Philippines has abundant groundwater supplies. These supplies could be used for agricultural, domestic, municipal and industrial purposes to improve the economy of the province. Large quantities of groundwater are available in deposits of sand which material comprises most of the aquifers. The best aquifers are located about 300 to 700 ft below the ground surface, and their thickness ranges from 100 to 400 ft. These aquifers are generally covered by clay deposits of varying thickness near the land surface. The recharge area is the exposed Bamban formation near the Zambales mountain range which is replenished by rainfall directly percolating to the fountainhead of these aquifers. The general direction of flow is southeast to east. The slope near the mountains is steep but flattens out in the plains. Above the clay deposits are shallow water-table aquifers which store water percolating directly from rainfall and from leaks in the lower artesian aquifers. Most of the dug and drilled wells in Pampanga which are used for domestic purposes draw their supplies from the water-table aquifers. Deeper wells drilled by the National Waterworks and Sewerage Authority derive their water supplies from the confined aquifers. (Knapp-USGS)
W69-09948

IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS,
California Univ., Los Angeles.

John A. Dracup, Yacov Y. Haimes, and Richard L. Perrine.
Proc, Fourth Amer Water Resources Conf, N Y, p 399-413, Nov 1968. 15 p, 2 fig, 15 ref.

Descriptors: *Aquifers, *Distribution systems, *Transmissivity, *Mathematical models, *Transit flow, Storage capacity, Dimensional analysis.

Transmissivity and storage parameters of wedge-shaped homogeneous regions of a distributed unconfined aquifer system were identified. An analytical solution was approximated to the nonlinear partial differential equation, which governed the transient groundwater flow in an unconfined aquifer. The dimensionality of the distributed parameter problem was reduced by decomposition and multilevel techniques. A direct search method was utilized in the first level, while the Gauss-Seidel type of algorithm was utilized as a second level controller. (Thiuri-Cornell)
W69-10019

INITIAL PERIODICITY OF NEW GEYSER, YELLOWSTONE NATIONAL PARK,
Kansas Univ., Lawrence. Dept. of Geology; and State Univ. of New York, Albany. Atmospheric Sciences Research Center.

Wakefield Dort, Jr., Austin W. Hogan, and G. William Reynolds, Jr.
J Geophys Res, Vol 74, No 17, p 4206-4208, Aug 15, 1969. 3 p, 2 fig, 1 tab.

Descriptors: *Geysers, *Wyoming, Hot springs, Thermal springs, Frequency, Groundwater movement, Timing.
Identifiers: *Yellowstone National Park.

A new geyser, having surface and subsurface connections with the Spectacle Pools, Yellowstone National Park, had a remarkable constant initial periodicity. Eruptive play generally occurred every 35-40 minutes and lasted 80-100 seconds. Water levels and temperatures of the associated pools exhibited consistent variations during each cycle. (Knapp-USGS)
W69-10078

GROUND-WATER LEVELS IN IDAHO, 1969,
Geological Survey, Boise, Idaho.
H. G. Sisco, and R. L. Whitehead.
Idaho Dep Reclam Water Inform Bull No 11, July 1969. 75 p, 93 ref.

Descriptors: *Water levels, *Observation wells, *Idaho, *Data collections, Hydrologic data, Water level fluctuations, Hydrographs.
Identifiers: *Idaho observation well network.

Water levels in water wells of the Idaho observation well network in the water year 1969 are tabulated. Water level changes are shown by hydrographs. Maps show the locations of all network wells, the water levels measured in spring 1969, and water level changes between spring 1968 and spring 1969. (Knapp-USGS)
W69-10081

WATER-LEVEL CHANGES 1964-1968, NORTHERN HIGH PLAINS OF COLORADO,
Geological Survey, Denver, Colo.
Arnold J. Boettcher, and Thomas J. Major.
Geol Surv Open-file Rep, Apr 1969. 3 p, 1 fig, 1 plate.

Descriptors: *Water levels, *Aquifers, *Colorado, *Surveys, Water yield, Irrigation water, Water level fluctuations, Water wells, Discharge (Water).
Identifiers: Ogallala Formation (Colo), High Plains.

Groundwater withdrawals for irrigation nearly quadrupled between 1960 to 1968 in the northern High Plains of Colorado. Groundwater use in-

Field 02—WATER CYCLE

Group 2F—Groundwater

creased from 82,000 to 308,000 acre-feet per year because of the rapidly growing number of irrigation wells (from 480 wells in 1960 to 1,810 in 1968). Utilization of the resource at this rate has caused significant water-level decline in areas where wells are concentrated and has alerted water managers to the need for an intensive study of the water resources of the area. Such a study was begun in 1968 to provide information for wise administration and management of the resource. Water levels and water-level changes are mapped, based on measurements in 400 wells in the Ogallala aquifer. (Knapp-USGS)
W69-10094

WATER RESOURCES OF THE JOPLIN AREA, MISSOURI,
Geological Survey, Rolla, Mo. Water Resources Div.
G. L. Feder, John Skelton, H. G. Jeffery, and E. J. Harvey.
Missouri Geol Surv and Water Resources Rep No 24, Mar 1969. 97 p, 28 fig, 1 plate, 11 tab, 24 ref, 7 append.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Surveys, *Missouri, Water wells, Streamflow, Springs, Water yield, Water quality, Aquifers, Hydrogeology, Data collections, Hydrologic data, Water sources.

Identifiers: Joplin (Mo).

Water supplies in the Joplin area, Missouri are available from streams, the shallow aquifer (limestone of Mississippian age), and the deep aquifer (dolomite and sandstone of Ordovician and Cambrian ages). The shallow aquifer supplies the baseflow of the area's streams, and also provides some recharge to the deep aquifer. Although recharge to the shallow aquifer occurs within the area, most of the recharge to the deep aquifer occurs outside the area. The average discharge of the area's streams is about 1 billion gpd, and the flow exceeds 150 million gpd 90% of the time. Flooding is not a serious problem at present. Stream water is generally of good quality and is a calcium bicarbonate type. Most wells in the deep aquifer yield 100 to 300 gpm. The water is of good quality, and is a calcium magnesium bicarbonate type with a range in dissolved solids of 140 to 290 (mg/l). Water supplies from the shallow aquifer can be obtained from wells, mine workings, and springs. Yields of wells in the shallow aquifer range from less than 10 gpm to more than 300 gpm. The dissolved-solids content of well water ranges from 162 to 981 mg/l, with a median value of 288 mg/l. The water is generally a calcium bicarbonate type. Due to the poor quality of mine water most uses will be restricted to industry. Disposal of mine water may present a problem to users. There are numerous springs in the area, with many yielding 100 to 500 gpm. The water is generally of good quality. At present about 20 mgd of water is being used in the area, of which about 8 mgd is pumped from streams. (Knapp-USGS)
W69-10095

SURFACE-WATER DISCHARGE AND GROUND-WATER LEVELS IN THE EAST FORK RIVER AREA, SUBLTE COUNTY, WYOMING,
Geological Survey, Riverton, Wyo.
For primary bibliographic entry see Field 02E.
W69-10097

HYDROGEOLOGY OF THE SCIOTO RIVER VALLEY NEAR PIKETON, SOUTH-CENTRAL OHIO,
Geological Survey, Washington, D.C.
Stanley E. Norris, and Richard E. Fidler.
Geol Surv Water-Supply Pap 1872, 1969. 70 p, 19 fig, 4 plate, 3 tab, 29 ref.

Descriptors: *Hydrogeology, *Alluvium, *Glacial drift, *Ohio, Water supply, Water wells, Transmissivity, Recharge, Water yield, Infiltration, Induced infiltration, Hydrologic data, Data collections.

Identifiers: Aquifer tests, Scioto River Valley (Ohio).

A systematic study was made of one of Ohio's principal aquifers, a sand and gravel outwash in the Scioto River Valley, to determine the feasibility of developing a groundwater supply of 20 mgd at a site near Piketon. The thickness and physical properties of the sand and gravel aquifer were determined and test wells were drilled to determine the best sites for supply wells. An aquifer infiltration test was made to determine the hydraulic properties of the aquifer and the conditions of stream recharge. A well 83 ft deep was drilled on the flood plain and was pumped for 9 days at the rate of 1,000 gpm. The effect on the hydrologic system during and after the pumping was determined by measuring the water levels in an array of deep and shallow observation wells and in 8 drive-point wells installed in the bed of the river. Seldom have more comprehensive data been collected showing the effects of pumping on a natural, unconfined, hydrologic system. From these data were calculated the coefficient of transmissibility (215,000 gpd/ft) and the rate of streambed infiltration (0.235 mgd/day/acre/ft). The aquifer was tested near the end of a long drought, so the groundwater levels and the river stage were very nearly following a level trend. (Knapp-USGS)
W69-10105

EFFECT OF TECTONIC STRUCTURE ON THE OCCURRENCE OF GROUND WATER IN THE BASALT OF THE COLUMBIA RIVER GROUP OF THE DALLES AREA, OREGON AND WASHINGTON,

Geological Survey, Washington, D.C.

R. C. Newcomb.

Geol Surv Prof Pap 383-C, p C1-C33, 1969. 33 p, 18 fig, 1 plate, 28 ref.

Descriptors: *Groundwater, *Basalts, *Springs, *Oregon, *Washington, Groundwater movement, Aquifers, Geology, Hydrogeology, Mapping, Porosity, Permeability, Water supply, Water yield, Discharge (Water), Recharge, Columbia River.
Identifiers: The Dalles (Oregon-Wash.).

The 620 sq-mi area studied lies across the boundary of the Cascade Range and Columbia Plateaus. The rubby tops of some of the lava flows and the brecciated flows within the sequence form aquifers that yield large to small amounts of water to wells and springs. The yield of the aquifers depends on the hydrologic conditions and structural situation. Groundwater in the basalt aquifers occurs mainly under three situations: (1) beneath the regional, or main, water table near river level, (2) perched at intermediate altitude near baseleveled secondary streams, and (3) perched at high levels near the top of the basalt in the uplands. Tectonic structure affects groundwater conditions in the basalt by the inclination of the aquifers, by formation of barriers to lateral percolation, by creation of avenues for some vertical movement, and by production of inlets for recharge and outlets for discharge. Together with stratigraphic discontinuities, the structural barriers have caused the impoundment of groundwater in the basalt above the main water table. The levels of the outlets around barriers determine the uppermost level to which the obstructed groundwater rises. The close relation between the tectonic structure and the occurrence of groundwater in the basalt can be used to make better predictions of drilling results. The structural criteria for groundwater storage can be projected elsewhere in the basalt region. An accurate map of the geology, and particularly of the geologic structures, has been found imperative to the interpretation of the groundwater occurrences. (Knapp-USGS)
W69-10107

HYDROLOGY OF A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W69-10110

ASPECTS OF THE OCCURRENCE AND MIGRATION OF NIOBUM, BERYLLIUM, AND RARE EARTHS IN NATURAL ALKALINE WATERS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 02K.
W69-10116

ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS,
Akademiya Nauk Kazakhskoi SSR, Alma-Ata; and Akademiya Nauk SSSR, Moscow. Institut Geologii.
For primary bibliographic entry see Field 02K.
W69-10117

NATURAL RADIODELMENTS IN SURFACE AND UNDERGROUND WATERS,
Akademiya Nauk SSSR, Moscow. Institut Geokhimiia i Analiticheskoi Khimii.
For primary bibliographic entry see Field 02K.
W69-10118

ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM,
Ministerstvo Geologii, Moscow (USSR); and Vsesoyuznyi Nauchno-Issledovatelskii Institut Yadernoi Geofiziki i Geokhimi, Moscow (USSR).
For primary bibliographic entry see Field 02K.
W69-10119

ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS,
Vsesoyuznyi Nauchno-Issledovatelskii Institut Neftekhimicheskikh Protessov, Leningrad (USSR).
For primary bibliographic entry see Field 02K.
W69-10120

FLUORINE IN THE REGIONALLY METAMORPHOSED SKARNS OF THE CZECH MASSIF (CZECHOSLOVAKIAN),
Geological Inst., Jihlava (Czechoslovakia).
For primary bibliographic entry see Field 02K.
W69-10123

ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS,
Institut Prirodnoi Gazy, Moscow (USSR).
For primary bibliographic entry see Field 02K.
W69-10124

WATER RECORDS OF PUERTO RICO, 1958-63,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W69-10134

LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA,
Bureau of Reclamation, Sacramento, Calif.
For primary bibliographic entry see Field 04B.
W69-10135

SUMMARY OF HYDROLOGIC AND PHYSICAL PROPERTIES OF ROCK AND SOIL MATERIALS, AS ANALYZED BY THE HYDROLOGIC LABORATORY OF THE U.S. GEOLOGICAL SURVEY, 1948-60,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W69-10143

WATER-BEARING CHARACTERISTICS AND OCCURRENCE OF AQUIFERS IN MARTIN COUNTY, NORTH CAROLINA,
Geological Survey, Washington, D.C.
Granville G. Wyrick.

Geol Surv Hydrol Invest Atlas HA-264, 1 sheet, 1967. Text, 1 fig, 1 map, 1 tab.

Descriptors: *Water resources, *Groundwater, *North Carolina, Aquifers, Artesian wells, Permeability, Recharge, Water yield, Water supply, Water wells, Water quality, Hydrogeology, Hydrologic data, Coastal plains.

Identifiers: *Martin County (NC).

The water resources and hydrogeology of Martin County, North Carolina are discussed in a 1-sheet hydrological atlas consisting of a map, tables, and text. Sedimentary rocks underlying Martin County thicken from west to east from about 400 to 1,000 ft. The sediments consist of clay, sand, shell, and limestone of cretaceous to Recent age deposited on crystalline basement rock. Average transmissibility of the artesian aquifers ranges from 4,000 gpd/ft to 18,000 gpd/ft. Average daily recharge is computed as 22 million gpd for aquifers between 100 and 300 ft below land surface. The depth below land surface, thickness, and quality of contained water is given for each principal aquifer in the County at each intersection of a 2-mi grid system, superposed on the county map. Specific capacities of wells tapping each aquifer are given in tables; specific capacities of wells tapping all underlying fresh-water aquifers are shown by colors on the map. The text describes geologic units and discussed well-screen sizes for various aquifers. (Knapp-USGS) W69-10144

HYDROGEOLGY OF THE UPPER CAPIBARIBE BASIN PERNAMBUCO, BRAZIL A RECONNAISSANCE IN AN AREA OF CRYSTALLINE ROCKS,
Superintendencia do Desenvolvimento do Nordeste (Brazil); and Geological Survey, Washington, D.C.
L. G. C. Filho, M. D. Pessoa, and W. C. Sinclair.
Geol Surv Water-Supply Pap 1663-E, 1966. 44 p, 3 fig, 1 plate, 6 tab, 30 ref.

Descriptors: *Water resources, *Groundwater, Water wells, Aquifers, Water quality, Water resources development, Water supply, Hydrologic data, Hydrogeology, Water yield, Crystalline rocks. Identifiers: *Brazil, Capibaribe Basin, Pernambuco.

The upper Capibaribe basin is within the Drought Polygon of northeast Brazil, and it totals 5,400 sq km. It receives relatively abundant precipitation, yet is regarded as hot subhumid to semi-arid because the precipitation is uneven from year to year and place to place. The dependable water supply, therefore, is small. The basin has water which could be put to better use than at present, but the opportunities for augmenting the usable supply are not great. The streams are intermittent and therefore cannot be expected to fill surface reservoirs and to keep them filled. The ground-water reservoirs have small capacity. A rough estimate based on the records for 1964 suggests that, of 4,700 million cu m of precipitation in the upper Capibaribe basin, 57% left the basin as runoff and 43% went into underground storage or was evaporated or transpired. The bedrock of the upper Capibaribe basin is composed of granite, gneiss, schist, and other varieties of crystalline rocks, which have only insignificant primary permeability. They are permeable mainly where fractured. A well in a large water-filled fracture zone may yield up to 20,000 liters per hour, but the average well yields less than 1/4 this amount, and some wells yield none. The saprolite contains water locally, but ordinarily will yield only small quantities to wells. The alluvium contains variable amounts of silty sand capable of yielding small to moderate quantities of water to wells. The chemical quality of the water in the upper Capibaribe basin ranges from good to bad and generally presents a major problem. (Knapp-USGS) W69-10145

USE OF A MATHEMATICAL MODEL IN THE HYDROLOGIC STUDY AS APPLIED TO THE VEGA DE GRENADE OF SPAIN (FRENCH),
F. Mortier, R. G. Thomas, and N. O. Trac.
Bull Int Ass Sci Hydrol, Vol 14, No 1, p 7-17, Mar 1969. 11 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Mathematical models, *Groundwater basins, Hydrologic properties, *Aquifers, Irrigation, Mapping, Gaging stations, Topography, Water wells, Electrical studies, Piezometers, Depression, River basins, Precipitation (Atmospheric), Infiltration, Tertiary period, Transmissivity, Water storage, Water balance, Water levels, Pumping.
Identifiers: *Spain, The Vega de Grenade.

The mathematical modeling technique developed by the Department of Water Resources of California was applied to the hydrologic study of an aquifer located in the Vega de Grenade, Spain, a basin of 200 sq mi. For the purpose of mathematical modeling, the basin was subdivided into 26 areas of 4.9 to 16.3 sq km and to these subareas were applied to recorded data pertaining to topography, dynamic water level, permeability, storage coefficient, water balance, and pumping data. The application of a mathematical model to the observed hydrologic data requires a relatively small expenditure in money and time, and is capable of identifying reasonably well the pertinent aquifer characteristics. (Gabriel-USGS) W69-10147

2G. Water in Soils

MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH),
Department of Agronomical Sciences of the State, Gembloux (Belgium).

For primary bibliographic entry see Field 07B.

W69-09904

MICROWAVE RADIOMETRIC SENSING OF SOIL MOISTURE CONTENT,
Aerojet-General Corp., El Monte, Calif. Space Div.
For primary bibliographic entry see Field 07B.
W69-09916

MOISTURE MOVEMENT TO A FREEZING FRONT,
Army Terrestrial Sciences Center, Hanover, N.H.
Pieter Hoekstra.
Symp on Geochem, Precipitation, Evaporation, Soil-Moisture, Hydrom, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Publ No 78, p 411-417, 1968. 7 p, 5 fig, 5 ref.

Descriptors: *Soil water movement, *Freezing, *Mass transport, Diffusion, Clays, Temperature, Porous media, Unsaturated flow.
Identifiers: Temperature gradients, Moisture gradients.

Moisture movement in an unsaturated clay, silt and sand caused by freezing is studied in a laboratory soil column by the attenuation of gamma-radiation. The cumulative water transport from the unfrozen part of the column into the frozen part is directly proportional to the square root of time. The boundary between frozen and unfrozen soil can apparently be treated as a constant soil water tension boundary. By setting the warm plate at 0.1 deg C and the cold plate at -10 deg C a very small temperature gradient exists in the unfrozen part of the column. Nevertheless, moisture migration from the unfrozen into the frozen part of the soil occurs. The moisture movement in the unfrozen part of the column takes place under the influence of a water content gradient. Moisture is redistributed in the frozen part of the soil by movement of water through the liquid-like transitional layer on the particle surfaces. The amount of moisture migration during freezing is of such magnitude that it is of importance in engineering and agriculture. (Knapp-USGS) W69-09928

EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-09986

MEASURING MOISTURE NEAR SOIL SURFACE. . .MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-09987

MECHANICS AND RATES OF NATURAL SOIL CREEP,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-09988

LEACHABILITY OF A WETTING-AGENT TREATMENT FOR WATER-RESISTANT SOILS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
J. S. Krammes, and L. F. DeBano.
Soil Sci Soc Amer Proc 31 (5): 709-711, illus, 1967.

Descriptors: *Watershed management, *Erosion control, Soils, Soil conservation, Hydrology, Overland flow, Wettability, Burning, Forest fires.
Identifiers: Southern California, Chaparral watersheds, Wetting agents, Water repellent soils.

Results from a laboratory leaching study showed that the wetting agent treatment persisted after 40 cm. of water had passed through soil samples. (Krammes-Forest Service) W69-09989

SOIL WETTABILITY: A NEGLECTED FACTOR IN WATERSHED MANAGEMENT,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
Jay S. Krammes, and L. F. DeBano.
Water Resources Res, Vol 1, No 2, Second quarter 1965. p 283-286, illus.

Descriptors: *Watershed management, *Infiltration, *Hydrology, Wettability, Erosion, Soils, Floods, Sedimentation, Sediment yield, Soil moisture, Overland flow, Permeability, Burning, Forest fires, California.
Identifiers: *Water repellent soils.

Uneven soil-moisture penetration has been observed and recorded after several southern California wildfires. This condition seems to be associated with an organic coating on the soil particles which makes the soil hydrophobic. (Krammes-Forest Service) W69-09991

IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS,
California Univ., Los Angeles.
For primary bibliographic entry see Field 02F.
W69-10019

DEVELOPED EQUATION OF THE WATER BALANCE (POLISH),
For primary bibliographic entry see Field 02A.
W69-10108

ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS,
State Hydrological Inst., Leningrad (USSR).
A. D. Kleshchenko, and Yu. I. Chirkov.

Field 02—WATER CYCLE

Group 2G—Water in Soils

Transl from Trudy Gidro-meteorologcheskogo nauchno-issledovatel'skogo tsentra SSSR, No 14, 1968, p 107-116. Soviet Hydrol Selec Pap No 3, p 270-277, 1968. 8 p, 3 tab, 11 ref.

Descriptors: *Soil moisture, *Soil-water-plant relationships, *Water storage, *Vegetation effects, *Meteorology, Correlation analysis, Regression analysis, Evapotranspiration, Moisture content, Statistical methods, Correlation analysis, Regression analysis.

Identifiers: USSR.

Meteorological observations in Moscow and Kaluga provinces were related to soil moisture content and row crop data by multiple regression analysis. The meteorological data used were air temperature, relative humidity, moisture deficit, wind force, clouds, number of days, with precipitation, and the amount of precipitation. Crop data were leaf surface area, density of planting, stage of plant development and soil moisture, in corn and potatoes. Correlation coefficients were calculated and tabulated. The variation in soil moisture was determined mainly by precipitation, number of rainy days, and cloudiness, and less by the stage of plant development, initial moisture and wind velocity. (Knapp-USGS)
W69-10130

WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER,
Agricultural Research Service, Riverside, Calif. Salinity Lab.
For primary bibliographic entry see Field 02D.
W69-10136

2H. Lakes

CHEMISTRY OF N AND MN IN COX HOLLOW LAKE,
Florida Univ., Gainesville.
For primary bibliographic entry see Field 05A.
W69-09881

UNSTEADY CIRCULATION IN SHALLOW LAKES,
Cornell Univ., Ithaca, N.Y.
J. A. Liggett.
ASCE Proc, J Hydraul Div, Vol 95, No HY 4, Pap 6686, p 1273-1288, July 1969. 16 p, 7 fig, 10 ref, 2 append.

Descriptors: *Water circulation, *Unsteady flow, *Lakes, Mathematical studies, Model studies, Mathematical models, Winds, Currents (Water), Digital computers.
Identifiers: Lake circulation.

A method is presented for calculating the three-dimensional, unsteady, wind-driven circulation in a shallow, homogeneous lake on a rotating earth. The equations of motion are linearized, boundary friction is assumed to act only on the bottom; and a constant eddy viscosity is assumed. These approximations assume a shallow lake where a characteristic horizontal dimension is large compared to the maximum depth and where the depth is of the order of magnitude of the Ekman 'depth of frictional influence' or less. The solution can be applied to a lake of arbitrary plan form and bottom topography. (Knapp-USGS)
W69-09886

RIVERS AND LAKES OF THE MONGOLIAN PEOPLE'S REPUBLIC (RUSSIAN),
Gidrometeorologicheskii Institut, Leningrad (USSR).

For primary bibliographic entry see Field 02E.
W69-09941

EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA: CLADOCERA): A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY,

Freshwater Biological Association, Ambleside (England).

G. Fryer.

Philosophical Transactions of The Royal Society of London, Vol 254, B 795, p 221-385, 1968. 155 fig, 3 tab, 72 ref.

Descriptors: *Crustacea, *Ecology, Lakes, Aquatic habitats, Systematics, Food habits, Niches, Behavior, Phylogeny.

Identifiers: *Comparative morphology, *Evolution, *Adaptive radiation, *Cladocera, *Functional morphology, *Chydoridae, *Comparative studies, Anomopoda, Alonopsis elongata, Aceroperus harpae, Camptocercus rectirostris, Alona affinis, Alona, Peracantha truncata, Pleuroxus, Alonella exigua, Alonella excisa, Alonella nana, Disparalona rostrata, Dadaya macrops, Graptoleberis testudinaria, Psuedochydorus globosus, Anchistropus emarginatus, Chydorus, Leydigia leydigii, Monospilus dispar.

Author presents an extensive account of the functional morphology, habits, ecology, and feeding mechanisms of a representative series of anomopod cladocerans of the family Chydoridae, embracing some 22 species belonging to 15 genera. Two genera are here defined as new. The report is said to be the first part of a general survey of Cladocera Anomopoda. Scope of report is indicated by coverage of individual sections as follows: introduction; methods; structure, habits of Anomopoda, especially Chydoridae; structure, feeding mechanism of Alonopsis elongata; structure, affinities, habits of Aceroperus harpae; structure, habits of Camptocercus rectirostris; structure, habits, feeding mechanism of Alona affinis; smaller Alona compared; structure, habits, feeding mechanism of Peracantha truncata; two Pleuroxus species compared; structure, habits, feeding mechanism of Alonella exigua; habits, abilities of Alonella excisa compared with A. exigua; structure, habits of A. nana compared with related species; phyletic divergence of Disparalona rostrata; novel niche of Dadaya macrops; structure, feeding mechanism of Graptoleberis testudinaria; structure, habits, feeding mechanism of scavenging Pseudochydorus globosus; structure, habits, feeding mechanism of parasitic Anchistropus emarginatus; exploitation of globular form by Chydorus; mud-adapted Leydigia leydigii; benthic-adapted Monospilus dispar; intergeneric relationships of Chydoridae; and adaptive radiation. (Eichhorn-Wis)
W69-10149

FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO MOUNTAIN LAKES,

Colorado Univ., Boulder. Dept. of Biology.

Robert W. Pennak.

Ecology, Vol 49, No 3, p 505-520, Late Spring 1968. 8 fig, 15 tab, 36 ref.

Descriptors: *Limnology, *Colorado, *Lakes, *Mountains, *Winter, Cyanophyta, Plankton, Copepods, Eutrophication, Oligotrophy, Temperature, Photosynthesis, Rainbow trout, Diatoms, Anaerobic conditions, Algae, Rotifers, Seston, Respiration, Altitude, Sampling, Zooplankton, Phytoplankton, Ice, Bacteria, Tripton, Bottom sediments, Solar radiation, Oxygen, Carbon dioxide, Nannoplankton.

Identifiers: *Field studies, *Experimental limnology, Cladoceran, Montane zone, Alpine zone, Boulder (Colo), Tea Lake (Colo), Black Lake (Colo), Pass Lake (Colo), Micro-algae, Flagellates, Ciliates, Copepods, Nauplii, Terramycin, Tetracycline, Streptomycin, Milipore filtration, Mesotrophy.

Physical, chemical, and planktonic conditions were studied during two winters in Colorado mountain

lakes--Black Lake (mesotrophic), Pass Lake (highly oligotrophic), Tea Lake (shallow, eutrophic, and pondlike). Winter temperatures of lower waters of Black and Pass Lakes are above 4 deg C and as high as 5.4 deg C. Substrate and bottom waters reach equilibrium in late February or March. Thick snow covered Black and Pass Lakes and no photosynthesis occurred for 5-7 months, but Tea Lake had little snow and intermittent photosynthesis during all winter. Black and Pass Lakes are summer-oligotrophic and winter-eutrophic. They became so highly anaerobic by March and April that trout populations died. All three lakes had negligible winter populations of diatoms and green and blue-green algae, but populations of micro-algae attained winter maxima of 1-14.5 million cells per liter, with no consistent seasonal pattern. Winter copepod and cladoceran populations were negligible. Rotifer populations were usually dense, especially during December and January, before onset of anaerobiosis. Seston varied more widely during months of open water. Winter plankton had average respiratory rate in situ of about twice that in corresponding samples kept in dark refrigerator at 3 deg C. (Jones-Wis)
W69-10154

CHANGES IN WESTERN LAKE ERIE DURING THE PERIOD 1948-1962,

Bowling Green State Univ., Ohio.

Jacob Verduin.

Proc of International Assoc of Theoretical and Applied Limnology, Vol 15, p 639-644, Feb 1961. 1 fig, 2 tab, 5 ref.

Descriptors: *Eutrophication, *Lake Erie, Seiches, Sampling, Silts, Nutrients, Light penetration, Physical properties, Phytoplankton, Benthic fauna, Fish, Agricultural watersheds, Detergents, Lakes, Hydrogen ion concentration, Nitrates, Phosphates.

Identifiers: *Lake changes, Lake studies, Chemical changes, Biotia changes, Oxygen depletion, Carbon dioxide (Daily changes), Chemical fertilizers, Put-in-Bay (Ohio), Detroit River, Maumee River (Ohio), Maumee Bay (Ohio), Asterionella formosa, Tabellaria fenestrata, Melosira ambigua, Fragilaria capucina, Coscinodiscus radiatus, Melosira binderana, Hexagonia limbata, Tendipes plumosus, Stizostedion vitreum vitreum, Perca flavescens, Osmerus mordax.

Extensive studies of western Lake Erie have been made since 1948. The area of approximately 3100 square kilometers is stirred continually by the seiches resulting in relatively homogeneous temperatures, chemical characteristics, and biological populations vertically. The Detroit River enters the basin's northwest corner contributing most of the water flowing through the lake. The Maumee River enters at the southwest corner, adding most of the silt load and nutrients to the lake. About 100 years ago the land of the Maumee watershed was drained and converted from swamp to agricultural land. In the years from 1948-1962, major changes were observed in the phytoplankton, benthic fauna, and fish communities. Chemical changes also noted include decreasing oxygen saturation near the bottom, increasing pH maxima, increasing carbon dioxide change rates per day, and increasing nitrate and phosphate levels. All these changes suggest an enrichment of western Lake Erie occurring rather sharply between 1949 and 1953. Records of nitrate and phosphate concentrations for the Maumee River show that it contributes significantly greater nutrient supplies to western Lake Erie than it did fifteen years ago. This can be attributed primarily to increased fertilization on farms in the river's watershed. (Kettelle-Wis)
W69-10156

EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO,

Scarborough Coll., Toronto (Ontario).

For primary bibliographic entry see Field 05C.

W69-10158

ON CONTROL OF LAKE EUTROPHICATION: EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS—(IN GERMAN),
 Kantonales Laboratorium, Zurich (Switzerland).
 For primary bibliographic entry see Field 05C.
 W69-10164

SOME FEATURES OF SALINE LAKES IN CENTRAL WASHINGTON,
 Washington Univ., Seattle. Dept. of Zoology; and Washington Univ., Seattle. Dept. of Oceanography. W. T. Edmondson, and George C. Anderson. Limnology and Oceanography, Vol 10, Supplement, p R87-R96. Nov 1965, 6 fig, 2 tab, 18 ref.

Descriptors: *Washington, *Limnology, *Saline lakes, Arid climates, Radioactivity, Temperature, Salinity, Conductivity, Epilimnion, Thermocline, Sagebrush, Seiches, Tracers, Gamma rays, Depth, Currents (Water), Diffusion, Lakes, Meromixis. Identifiers: Chemocline, Radioactive rubidium, Soap Lake (Wash), Lower Grand Coulee (Wash), Mixolimnion, Gradient, Monimolimnion, Rubidium-86, Mirabilite.

The central part of the State of Washington has an arid climate and contains a number of saline lakes. Several are meromictic and show a variety of vertical gradients of salinity and temperature. Increased entry of fresh water has diluted mixolimnetic salinity of Soap Lake from 39.4 grams per liter in 1946 to 18.0 in 1964, while the monimolimnion has been maintained at more than 130 grams per liter. Stability of the chemocline was studied by injection of radioactive rubidium. The radioactivity spread laterally in all directions, mostly in a layer less than 2 meters thick, to a maximum observed mean radius of 53 meters in 13 days. The corresponding eddy diffusion coefficient is 3.2 square centimeters per second. Relating to the maintenance of meromixis was an observation that large crystals of mirabilite were found widely distributed on the bottom in contact with the monimolimnion. In the chemocline, there occurred irregular masses of mirabilite, as much as a decimeter across. Direct measurements were made of currents in the mixolimnion of Soap Lake by SCUBA divers. Currents were observed on two occasions by measuring the spread of dye markers at different depths and locations within the lake. (Jones-Wisc)
 W69-10165

SELF-ABSORPTION OF C-14 RADIATION IN FRESHWATER OSTRACODS,
 Michigan State Univ., Hickory Corners, W. K. Kellogg Biological Station; and Michigan State Univ., East Lansing. Dept. of Zoology. Don L. McGregor, and Robert C. Wetzel. Ecology, Vol 49, No 2, p 352-355, Early Spring 1968. 3 tab, 21 ref.

Descriptors: *Carbon radioisotopes, *Radioactivity, *Fresh water, Crustaceans, Aquatic insects, Oligochaetes, Fish, Tracers, Metabolism, Zooplankton, Larvae, Michigan, Detritus, Phytoplankton, Bacteria, Size, Rotifers, Copepods, Insects, Mollusks, Volume, Life cycles. Identifiers: *Ostracods, *Self-absorption, Carapace, Gull Lake (Mich), Lawrence Lake (Mich), Species effects, Sexual effects, Instar effects, Reproductive state, Internal structures, Cladocera.

Radiocarbon is being used increasingly in studies of feeding and metabolism of zooplankton, small benthic invertebrates, and larval fish. Radioassays of incorporated carbon-14 are commonly made by counting in solid Geiger-Muller systems. Early investigations with radiocarbon-labeled microninvertebrates indicated or assumed that self-absorption of weak beta radiation was negligible. Subsequent work demonstrates that self-absorption of carbon-14 radiation may be significant even in small organisms and, if neglected in detailed metabolic studies,

can lead to substantial errors. Very little is known of nutrition and metabolism of freshwater ostracods. The need for self-absorption coefficients for ostracods developed during course of investigations because of expected high values in organisms whose bodies are entirely enclosed by a calcareous, bivalved carapace. Self-absorption coefficients of carbon-14 radiation, determined for six species of freshwater ostracods, varied with difference in size, sex, instar, reproductive state, and among species. Self-absorption is generally greater in ostracods than in other microcrustacea, some aquatic insects, oligochaetes, and fish larvae. Where carbon-14 is employed as a tracer in precise investigations on feeding and metabolism, variations in self-absorption of radiation must be considered in detail. (Jones-Wis)
 W69-10166

ALGAE AND PHOSPHORUS IN LAKE MINNETONKA,
 Minnesota Univ., Minneapolis. Limnological Research Center. For primary bibliographic entry see Field 05C.
 W69-10167

ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON,
 Washington Univ., Seattle. Dept. of Zoology. For primary bibliographic entry see Field 05C.
 W69-10169

SEDIMENTS FROM DANISH LAKES,
 Copenhagen Univ. (Denmark). Geographical Lab. Kaj Hansen. Journal of Sedimentary Petrology, Vol 29, No 1, p 38-46, March 1959. 3 fig, 4 tab, 28 ref.

Descriptors: *Lakes, *Lake soils, *Sediments, Silica, Calcium carbonate, Diatoms, Humus, Water chemistry, Soil chemistry, Palynology, Eutrophication, Oligotrophy. Identifiers: *Denmark, *Lake typology, Triangle diagrams, Polyhumous lakes, Silicon dioxide (Alkali-soluble), Carbon (Organic), Minerogenic ingredients, Frustules (Diatoms), Ratios (C/N), Evaluation (Methodology).

Analyses of lake muds included determination of organic matter by loss on ignition, inorganic biogenic components as alkali-soluble silicon dioxide and calcium carbonate, and the minerogenic components as the difference between the total and the alkali-soluble silicon dioxide. The two types of humus were delineated on the basis of the organic carbon content (below and above 50%) and carbon-to-nitrogen ratio (below and above 10). The relation between lake types and sediments is indicated by triangular diagrams whose sides represent organic carbon, mineral constituents, and diatom frustules plus calcium carbonate. (Wilde-Wis)
 W69-10174

THE IMPORTANCE OF EXTRACELLULAR PRODUCTS OF ALGAE IN FRESHWATER,
 University Coll., London (England). Dept. of Botany. For primary bibliographic entry see Field 05C.
 W69-10180

TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD,
 Biological Station, Lunz am See (Austria). Ingo Findenegg. Verh Int Verein Theor Angew Limnol, Vol 15, p 352-359, February 1964. 6 fig, 1 tab, 4 ref.

Descriptors: *Primary productivity, *Lakes, *Carbon radioisotopes, *Plankton, Photosynthesis, Epilimnion, Depth, Distribution, Light intensity, Energy losses, Phytoplankton, Radiation,

Oligotrophy, Eutrophication, Algae, Nutrients, Surfaces, Tracers, Limnology. Identifiers: *Eastern Alps, *Austria, *Lake typology, Carbon assimilation, Metalimnion, Ossiacher See (Austria), Zeller See (Austria), Attersee (Austria), Lunzer See (Austria), Langsee (Austria), Worthersee (Austria), Transparency, Transmission (Blue light), Area, Traunsee (Austria), Wolfgangsee (Austria), Millstatter See (Austria), Klopeiner See (Austria), Oscillatori rubescens, Transmission (Green light), Transmission (Red light), Mesotrophy.

Author investigated productivity of Austrian alpine lakes because their variety with regard to geological, morphological, and climatic conditions appeared suitable for this research. Planktonic primary production was measured by the carbon-14 method. Fieldwork, light measurement, counting and volumetrical evaluation of standing crop of plankton, activity measurement and its evaluation were performed. Spectral light-transmission was measured for blue, green, and red wavelengths. In comparing results, three types of curves were observed: In the first case, an extreme or a distinct maximum of assimilation is developed in the upper epilimnion, followed downwards by a more or less rapid decline. The second type shows no distinct maximum. Equally small amounts of carbon are assimilated from the surface down to 5, 8, or even 12 meters, and the photosynthetic layer may be 20 meters thick. This type, most commonly found in lakes of Austrian Alps is generally poor in plankton. The third type shows at least two maxima: one in the epilimnion, another in the metalimnion. Shape of the vertical assimilation curve appears to be much more informative as related to degree of eutrophication than is the amount of organic matter produced per surface unit. (Jones-Wis)
 W69-10181

CHANGES IN THE OXYGEN DEFICIT OF LAKE WASHINGTON,
 Washington Univ., Seattle. Dept. of Zoology. For primary bibliographic entry see Field 05C.
 W69-10182

21. Water in Plants

TRANSPORT OF INTERCEPTED SNOW FROM TREES DURING SNOW STORMS,
 Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 02C.
 W69-09998

HYDROLOGY OF FOREST LANDS AND RANGELANDS,
 Forest Service (USDA), Washington, D.C.; and Agricultural Research Service, Washington, D.C. For primary bibliographic entry see Field 02A.
 W69-10002

REPORT NO. 4: FOREST AND WATER RESEARCH PROJECT, DELAWARE-LEHIGH EXPERIMENTAL FOREST,
 Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station; and Pennsylvania Dept. of Forests and Waters, Harrisburg. For primary bibliographic entry see Field 02A.
 W69-10005

TECHNIQUES IN GRASSLAND WATERSHED RESEARCH,
 Forest Service (USDA), Washington, D.C. Div. of Watershed, Recreation, and Range Research. For primary bibliographic entry see Field 02A.
 W69-10007

ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES, 1967,
 Bureau of Reclamation, Denver, Colo. For primary bibliographic entry see Field 03B.

Field 02—WATER CYCLE

Group 2I—Water in Plants

W69-10126

ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS,
State Hydrological Inst., Leningrad (USSR).
For primary bibliographic entry see Field 02G.
W69-10130

ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES,
Vsesoiznnyi Nauchno-Issledovatel'skii Institut Neftekhimicheskikh Protessov, Moscow (USSR).
For primary bibliographic entry see Field 02K.
W69-10133

WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER,
Agricultural Research Service, Riverside, Calif. Salinity Lab.
For primary bibliographic entry see Field 02D.
W69-10136

2J. Erosion and Sedimentation

NATURE OF TURBIDITY IN THE ILLINOIS RIVER,
Illinois State Water Survey, Peoria.
Wun-Cheng Wang, and Daniel J. Brabec.
J Amer Water Works Ass, Vol 61, No 9, p 460-464, Sept 1969. 5 p, 7 fig, 1 tab, 17 ref.

Descriptors: *Turbidity, *Rivers, *Illinois, *Water quality, Provenance, Suspended load, Sediment yield, Water chemistry, Soil erosion, Runoff, Nutrients, Streamflow.
Identifiers: *Illinois River.

The major source of turbidity in the Illinois River is soil originating in land runoff. Water turbidity in the Illinois River was found to vary from day to day and from location to location. In general, there was a channel-shallows pattern as well as an upstream-downstream pattern in the study area. Turbidity in the river water was found to be related to the particulate phosphorus, silica, and iron (III) concentrations. The sum of the phosphorus and silica molecules was found to be exactly the same as the iron molecules. A stoichiometric relationship among these parameters is suggested. (Knapp-USGS)
W69-09885

DISPERSION OF FLOATING PARTICLES IN UNIFORM CHANNEL FLOW,
Technical Univ. of Denmark, Copenhagen.
Frank Engelund.
ASCE Proc, J Hydraul Div, Vol 95, No HY 4, Pap 6659, p 1149-1162, July 1969. 14 p, 7 fig, 6 tab, 11 ref, 2 append.

Descriptors: *Dispersion, *Diffusion, *Turbulent flow, *Open channel flow, Steady flow, Hydraulics, Turbulence, Model studies, Mathematical models, Boundary processes, Tracers, Tracking techniques.
Identifiers: Particle dispersion, Floating particles.

An investigation was made of the dispersion of small particles floating on the surface of an open channel with uniform flow and wide rectangular cross section. The dispersion was exclusively due to the diffusion caused by surface turbulence. The surface turbulence is two-dimensional, homogeneous and nondecaying. The dispersion experiments were supplemented by measurements of the turbulence intensities and correlation functions just below the surface of the water. The turbulence was found to be anisotropic, the longitudinal dispersion being nearly twice the lateral dispersion. By the application of an established relation between the Lagrangian and Eulerian correlation functions and

a principle of Reynolds' number similarity, a simple description of the one-particle diffusion is obtained. (Knapp-USGS)
W69-09887

INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT,
Texas Univ., Austin.
For primary bibliographic entry see Field 05B.
W69-09891

RESISTANCE TO REVERSING FLOWS OVER MOBILE BEDS,
Technical Univ. of Istanbul (Turkey).
For primary bibliographic entry see Field 02E.
W69-09892

FRICITION-FACTORS FOR FLAT-BED FLOWS IN SAND CHANNELS,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 02E.
W69-09893

GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECESSION IN THE NARVIKSK-JOMEN DISTRICT, NORWAY,
Uppsala Univ. (Sweden). Dept. of Physical Geography.
For primary bibliographic entry see Field 02C.
W69-09924

SEDIMENTATION IN BROWNELL CREEK SUBWATERSHED NO. 1, NEBRASKA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04D.
W69-09946

SEDIMENT--ITS CONSEQUENCES AND CONTROL,
Agricultural Research Service, Washington, D.C.; and Forest Service (USDA), Washington, D.C.
Louis M. Glymph, and Herbert C. Storey.
Proc Amer Ass Advance Sci Meeting, Agr and Quality of Our Environment Symp, Washington, D.C., Dec 1966. p 205-220.

Descriptors: *Erosion, *Sedimentation, *Soil conservation, *Soil erosion, *Sediment transport, Vegetation effects, Environmental effects, Watersheds (Basins), Watershed management, Reservoir silting, Sediment distribution, Erosion control.
Identifiers: *Sediment movement, Sediment deposition.

After a brief discussion of geologic erosion and modern orogeny, this paper details the consequences of sediment upon fish, recreation, domestic water supply, streams, reservoirs, and estuaries. The next section discusses control of sediment and finally lists 11 areas in which knowledge is lacking. An excellent list of references is included. (Reigner-Forest Ser)
W69-10003

INVESTIGATION OF WATER RESERVOIR BOTTOM DENSITY USING RADIOMETRIC METHODS (POLISH),
Jerzy Makowski, and Andrzej Lewandowski.
Polski Akad Nauk Rozpr Hydrotech, Part 23, p 297-309, 1969. 14 p, 6 fig, 1 tab, 4 ref.

Descriptors: *Bottom sediments, *Density, *Reservoirs, *Radioactivity techniques, Artificial water courses, Sands, Geology, Fissures (Geology), Porosity, Hydraulic properties, Water works, Tracers, Radiochemical analysis, Canals, Currents (Water), Infiltration, Radioisotopes, Rivers.
Identifiers: *Poland, Radiometric methods in hydrology, Water reservoir bottom density.

Because the bottom surfaces of water reservoirs often have spots of inferior density subject to excessive water infiltration, a radiometric method is suggested as suitable for the detection of these weak spots. The method consists in the formation of a uniform layer of radioactive solution over the reservoir bottom. This layer, on account of its heavier density than the surrounding water layer is precipitated on the reservoir bottom. The bottom spots, characterized by weaker density, absorb by infiltration a considerable amount of radioactive solution and show relatively smaller radioactive intensities on the basis of radioactivity surveys conducted after spreading of the radioactive substance. The method was tried on the reservoir of the Charna Pshemsha River and found entirely satisfactory. (Gabriel-USGS)
W69-10109

DEPOSITIONAL ENVIRONMENTS OF SUB-SURFACE POTOMAC GROUP IN MARYLAND,
Maryland Geological Survey, Baltimore.

Harry J. Hansen.
Amer Ass Petrol Geol Bull, VOL 53, No 9, p 1923-1937, 1969. 15 p, 14 fig, 1 tab, 42 ref.

Descriptors: *Aquifers, *Geologic formations, *Sedimentation, *Sedimentology, *Sands, Sandstones, Alluvium, Flood plains, Deltas, Meanders, Electrical well logging, Stratigraphy, Geology, Hydrogeology, Mesozoic era, Geohydrologic units.
Identifiers: *Potomac Group.

The Potomac Group of Cretaceous age in the Baltimore-Washington, D.C., area has been recognized for many years as a product of fluvial and paludal sedimentation. The location of Baltimore, near a landward bulge of the Baltimore Canyon trough, was the locus for fluvial sedimentation of braided or multistoried sands during the time of Patuxent (Barremian) and Patapsco (Albian) deposition. Because of the thickness and permeability, those deposits give relatively high coefficients of transmissibility, between 25,000 and 75,000 gpd/ft. In the context of the classic delta form, the area is the braided upper floodplain lithofacies of a major axial river system. Southward, toward the Potomac River, there are lithofacies associated with a floodplain of meandering streams and a fringing swamp zone. Aquifers in those sediments have transmissibility values from less than 5,000 to 25,000 gpd/ft. The sand content decreases southward from 45% to less than 25% in both the Patuxent and Patapsco Formations. Because of the lack of core data, electric logs are used to distinguish between the deposits of braided and meandering streams. (Knapp-USGS)
W69-10113

EXPERIMENTAL PALEOHYDROLOGIC INVESTIGATIONS,
Leningrad State Univ. (USSR). Dept. of Geography.
For primary bibliographic entry see Field 02E.
W69-10141

SUMMARY OF HYDROLOGIC AND PHYSICAL PROPERTIES OF ROCK AND SOIL MATERIALS, AS ANALYZED BY THE HYDROLOGIC LABORATORY OF THE U.S. GEOLOGICAL SURVEY, 1948-60,
Geological Survey, Washington, D.C.
D. A. Morris, and A. I. Johnson.
Geol Surv Water-Supply Pap 1839-D, p D1-D42, 1967. 42 p, 13 fig, 12 tab, 70 ref.

Descriptors: *Hydrologic data, *Data collections, *Rock properties, Permeability, Specific capacity, Specific gravity, Porosity, Moisture content, Particle size, Sands, Silts, Clays, Igneous rocks, Glacial drift, Metamorphic rocks, Sedimentary rocks, Carbonate rocks.
Identifiers: Hydrological Laboratory (USGS).

Summary statistical data are presented on the results of U. S. Geological Survey Hydrological

Chemical Processes—Group 2K

laboratory analyses of the hydrologic and physical properties of rock and soil types from 42 states. This information includes the range, number of rock matrix samples represented, and arithmetic mean. Most analyses are of sedimentary rocks, but details are also provided for igneous rocks, metamorphic rocks, and soil materials. Permeability, porosity, specific gravity of solids, centrifuge-moisture equivalent, and specific retention are listed for weathered granite and gabbro, basalt, sandstone, siltstone, claystone, and shale, silt, clay, loess, eolian sand, tuff, till, washed drift, limestone, dolomite, peat, slate, and schist. (Knapp-USGS) W69-10143

2K. Chemical Processes

NATURE OF TURBIDITY IN THE ILLINOIS RIVER,
Illinois State Water Survey, Peoria.
For primary bibliographic entry see Field 02J.
W69-09885

OBSERVATIONS OF GASES IN CHESAPEAKE BAY SEDIMENTS,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
William S. Reeburgh.
Limnol and Oceanogr, Vol 14, No 3, p 368-375, May 1969. 8 p, 6 fig, 17 ref.

Descriptors: *Water chemistry, *Estuaries, *Sediments, *Bays, *Gases, Seasonal, Argon, Nitrogen, Carbon dioxide, Methane, Sulfides, Sampling, Biological properties, Water temperature, Analytical techniques, Core drilling, Thermodynamic behavior, Water quality, Mineralogy, Diagenesis. Identifiers: Chesapeake Bay (Md) sediments.

Seasonal distribution of Ar, nitrogen, methane, and total carbon dioxide in Chesapeake Bay sediments was investigated on the basis of chemical analysis and bore drilling data. The methane contents increase with depth in the sediment from undetected quantities at the surface to concentrations of 150 and 85 ml/liter in water depths of 30.4 and 15.2 m, respectively. Ar and nitrogen are present in the surface sediments in concentrations near that of the overlying water and decrease with depth to values of 0.1 to 2 ml/liter. Stripping by bubbling of methane accounts for the selective removal of nitrogen and the decrease with depth of both Ar and nitrogen contents. Total carbon dioxide increases with depth up to 1,500 ml/liter concentrations. Low values of total hydrogen sulfide and an abundance of acid-labile sulfides in the sediments indicate the removal of sulfides species by mineral forming processes. (Gabriel-USGS) W69-09900

FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY,
Smithsonian Institution, Washington, D.C.
For primary bibliographic entry see Field 02L.
W69-09901

MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING BRINES, THE SABKHA, TRUCIAL COAST, ARABIAN GULF,
California Univ., Riverside.
For primary bibliographic entry see Field 02L.
W69-09906

DISTRIBUTION AND CIRCULATION OF THE MAJOR ELEMENTS IN SURFACE WATERS OF ITALY,
Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
Mario Dall'Aglio.
Symp on Geochem, Precipitation, Evaporation, Soil-Moisture, Hydrom, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Publ No 78, p 79-91, 1968. 13 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Trace elements, *Surface waters, *Surveys, Water chemistry, Water analysis, Chemical analysis, Geochemistry, Aqueous solutions. Identifiers: Italy, Geochemical prospecting.

During the geochemical prospecting surveys for uranium and other elements carried out by C.N.E.N. in Italy, about 5,000 samples of surface waters have been collected on an area of about 50,000 sq kilometers. The surveyed areas are representative of the most important geological formations outcropping in Italy. Determination of temperature, pH, electrical conductance and of the content of Ca, Mg, Na, K, carbonate, sulfate, Cl, and silica were performed on each water sample. Determination of F, B, phosphate, and heavy metals were also performed on about 2,000 water samples. Determination of mercury was performed on about 300 samples of both surface and ground-waters. This gives a good approximation of background values and geochemical behavior. Electrical conductance and the chemical composition of the Italian surface waters were correlated and patterns of distribution were calculated. (Knapp-USGS) W69-09922

URANIUM DISEQUILIBRIUM IN GROUND-WATER: AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS,
Florida State Univ., Tallahassee. Dept. of Geology. J. K. Osmond, H. S. Rydell, and M. I. Kaufman. Science, Vol 162, p 997-999, Nov 29, 1968. 3 p, 1 fig, 1 tab, 13 ref.

Descriptors: *Water chemistry, *Uranium radioisotopes, *Equilibrium, *Radioactive dating, *Tracers, Aquifers, Florida, Water circulation, Groundwater movement, Karst, Springs, Discharge (Water), Water sources, Mixing. Identifiers: Floridan aquifer, Isotope dilution analysis.

The distribution and environmental disequilibrium patterns of naturally occurring uranium isotopes U-234 and U-238 in waters of the Floridan aquifer suggest that variations in the ratios of isotopic activity and concentrations can be used quantitatively to evaluate mixing proportions of waters from differing sources. Uranium is probably unique in its potential for this approach, which seems to have general usefulness in hydrologic investigations. (Knapp-USGS) W69-09925

EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS—2. APPLICATIONS,
Northwestern Univ., Evanston, Ill. Dept. of Geology.
For primary bibliographic entry see Field 01B.
W69-10092

GEOCHEMICAL EVOLUTION OF OUED SAOURA (NORTHWESTERN SAHARA) WATERS (FRENCH),
Centre de Recherches sur les Zones Arides, Paris (France). P. Blanc, and G. Conrad.

Rev Geogr Phys et Geol Dyn Paris, Vol 10, No 5, p 415-428, Nov-Dec 1968. 14 p, 6 fig, 4 tab.

Descriptors: *Geochemistry, *Rivers, Streamflow, Floods, Water levels, Water level fluctuations, Discharge (Water), Water supply, Water chemistry, Water circulation, River beds, Water properties, Calcium, Magnesium, Sodium, Potassium, Chlorine, Sulfates, Sediments, Geology, Sands, Gypsum, Clays, Boreholes. Identifiers: *Africa, *Oued Saoura, Northwestern Sahara.

Geochemical evolution of streamflow waters in the northwestern Sahara were investigated on the basis of geochemical, hydrologic and geologic data recorded in 1965 and 1966. The study shows that in time of a flood, Saoura carries the waters of the

Atlas mountains province, supports a narrow band of vegetation in the desert areas of the northwestern Sahara, and carries soluble salts which concentrate at the extreme limit reached by the streamflow. Solid loads carried by streamflows consist of clays and sands and these loads do not modify the streambed morphology because of the short-time periods associated with the flood high-water marks. Salt concentrations are slowly diffused through the alluvium formations and water-bearing formations (aquifers) along the whole course of Oued Saoura, especially in the Melah and Sebhet areas where large accumulations of halite, gypsum, and some carnallite are present. (Gabriel-USGS) W69-10114

ASPECTS OF THE OCCURRENCE AND MIGRATION OF NIOBUM, BERYLLIUM, AND RARE EARTHS IN NATURAL ALKALINE WATERS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR). S. R. Kravov.

Geochem Int, Vol 5, No 2, p 315-325, 1968. 11 p, 6 fig, 5 tab, 22 ref. Transl from Geokhimiya, USSR, No 3, p 342-354, 1968. Published by Geochemical Society.

Descriptors: *Trace elements, *Elements (Chemical), *Aquifers, *Alkaline waters, *Surface waters, Hydrolysis, Mineralogy, Geochemistry, Anion exchange, Lakes, Colloids, Sampling, Chlorine, Calcium, Sulfates, Carbonates, Sodium, Potassium, Salinity, Nitrogen, Humid areas. Identifiers: Kola peninsula, Central Asia.

Alkaline water samples were collected in the Kola peninsula and Central Asia for the purpose of understanding the occurrence and migration of niobium, beryllium, and rare earths. The migration capacity of a hydrolyzed element in alkaline waters depends on the stability of the complexes formed with the anions in such waters. Nb and rare earths form complexes stable against hydrolysis; Be has a greater tendency to form cations, and its complexes in the supergene zone are stable mainly in acidic and neutral media. (Gabriel-USGS) W69-10116

ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS,
Akademiya Nauk Kazakhskoi SSR, Alma-Ata; and Akademiya Nauk SSSR, Moscow, Institut Geologii. N. B. Kadyrov, Ye. A. Isabayev, U. Kh. Asylbayev, A. Kh. Abildayev, and V. V. Cherdynsev.

Geochem Int, Vol 5, No 2, p 418-419, 1968. 2 p, 1 tab, 8 ref. Transl from Geokhimiya, USSR, No 4, p 492-494, 1968. Published by Geochemical Society.

Descriptors: *Uranium radioisotopes, *Mineralogy, *Surface waters, *Aquifers, Sampling, Sulfides, Oxides, Granites, Spectroscopy, Molybdenum, Electrolysis, Radium radioisotopes. Identifiers: *USSR, Kazakhstan and Armenia.

The U-234/U-238, U-235/U-238, and Ac-227/Ra-226 ratios in low uranium content sulfide and oxide minerals and in groundwater were investigated on the basis of earlier publications. The U-235/U-238 ratio in all samples varies by less than 1%. Sulfides may be deficient in U-234 by as much as 20%. Groundwater from granite is also enriched in U-234 by as much as 350%. Some minerals sampled are enriched in Ac-237 that does not correlate with U-234 enrichment. (Gabriel-USGS) W69-10117

NATURAL RADIODELMENTS IN SURFACE AND UNDERGROUND WATERS,
Akademiya Nauk SSSR, Moscow. Institut Geokhimi i Analiticheskoi Khimii. V. I. Varanov, N. G. Morozova, T. G. Ikimova, and A. V. Orlova.

Field 02—WATER CYCLE

Group 2K—Chemical Processes

Transl from Geokhimiya, USSR, No 3, p 334-341, 1968. For complete transl order Doc G168-3-9 (Varanov) from Amer Geol Inst, 1444 N St, NW, Wash DC, 2005 Price \$1.65.

Descriptors: *Aquifers, *Surface waters, *Radioisotopes, Lakes, Rivers, Soil water, Subsoil, Soils, Acid streams, Bogs.

Identifiers: *USSR, Estonian SSR.

Soil-Subsoil waters, lake and river waters of the Estonian SSR were analyzed for their content of radium, uranium and thorium. In all types of surface waters the equilibrium between U- and Ra is lacking. In soil-subsoil waters, lake and river waters the equilibrium is displaced towards U dominance over Ra. In lysimetric soil waters and acid waters of lowland bogs Ra is present in an amount considerably exceeding the equilibrium amount. Surface waters of all types are characterized by Th/U ratio considerably less than one, with the average values varying from 0.1 to 0.4. (Gabriel-USGS) W69-10118

ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM,

Ministerstvo Geologii, Moscow (USSR); and Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimi, Moscow (USSR). V. S. Brezgunov, L. S. Vlasova, and V. N. Soyer.

Transl from Geokhimiya, USSR, No 1, p 86-98, 1968. Published by Geochemical Society. Geochim Int, Vol 5, No 1, p 65-78, 1968. 14 p, 7 fig, 5 tab, 39 ref.

Descriptors: *Groundwater, *Aquifers, *Oil reservoirs, *Hydrogen, Deuterium, Neutron activation analysis, Sodium, Meteoric water, Statistics, Sampling, Geology, Tertiary period, Stagnant water, Surface waters, Water circulation, Salinity, Spectroscopy, Temperature.

Identifiers: *USSR.

Isotopic composition of hydrogen in the ground waters and oil field of the Dnepr-Donets, Irkutsk and other basins of the USSR was investigated using a photoneutron technique. The regularities of distribution of deuterium in natural waters may be used to solve certain hydrogeological problems related to origin of ground waters and their migration. Small variations of about 10% in the deuterium content of petroleum indicate similarity in the isotopic hydrogen content in crude oil progenitors. The concentrations of deuterium in oil field waters are evidently regulated by the same processes as in other types of ground water, and are unrelated to petroleum deposits. (Gabriel-USGS) W69-10119

ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS,

Vsesoyuznyi Nauchno-Issledovatel'skii Institut Neftekhimicheskikh Protsessov, Leningrad (USSR). A. N. Voronov, and V. V. Tikhomirov.

Transl from Geokhimiya, USSR, No 1, p 115-118, 1968. For copy of complete transl, order as Doc G168-1-15 Transl Office, Amer Geol Inst, 1444 N St NW, Wash, DC 20005, Price \$1.65.

Descriptors: *Groundwater, *Aquifers, *Argon, *Chemical analysis, Analytical techniques, Atmosphere, Statistical methods, Water chemistry, Correlation analysis.

Identifiers: *USSR.

Single factor variance analysis was applied to 2,000 analyses of argon concentrations in groundwater to estimate what portion of the total variation in reported argon concentrations is due to analytical errors and what portion to variability in nature. The total reported range is 0.01 to 8.0 cu cm/l. The range, eliminating that portion assignable to analytical errors, is 0.08 to 2.44 cu cm/l. This range is still too large to be explained by the hypothesis that argon in groundwater is entirely of atmospheric origin. (Gabriel-USGS) W69-10120

THORIUM ISOTOPES (Th-230, Th-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS,

Yu. V. Kuznetsov, Z. N. Simonyak, A. P. Lisitsyn, and M. S. Frenklikh.

Transl from Geokhimiya, USSR, No 2, p 218-227, 1968. Published by Geochemical Society. Geochim Int, Vol 5, No 1, p 169-177, 1968. 9 p, 3 tab, 16 ref.

Descriptors: *Radiochemical analysis, *Radioisotopes, *Sediments, *Indian Ocean, *Sediment-water interfaces, *Bottom sediments, Sedimentation rates, Chemical analysis, Iron compounds, Manganese, Phosphates, Sampling, Antarctic Ocean, Turbidity currents, Silica, Organic matter, Statistics, Carbon.

Identifiers: Thorium radioisotopes.

The content and distribution of Th-230 and Th-232 in the bottom sediments of the Indian Ocean at depths of 100 to 5,600 m were investigated by radiochemical analysis. The content of ionium (Th-230) in the surface layer of oceanic sediments depends on the depth of water, effective surface areas of the sedimentary particles, and the rate of sedimentation, whereas the dependence of thorium on the same parameters is of complex character. The two isotopes, however, are introduced into the sediments by two different mechanisms: ionium coprecipitates with the hydroxides and phosphates of iron and manganese, and thorium is associated with detrital particles. (Gabriel-USGS) W69-10121

SILICA IN AQUEOUS SOLUTIONS,

Akademiya Nauk SSSR, Moscow. Institut Geokhimi i Analiticheskoi Khimii.

For primary bibliographic entry see Field 01B.

W69-10122

FLUORINE IN THE REGIONALLY METAMORPHOSED SKARNS OF THE CZECH MASSIF (CZECHOSLOVAKIAN),

Geological Inst., Jihlava (Czechoslovakia).

D. Nemet.

Transl from Geokhimiya, USSR, No 2, p 190-197, 1968. Published by the Geochem Society. Geochim Int, Vol 5, No 1, p 141-147, 1968. 7 p, 1 fig, 5 tab, 7 ref.

Descriptors: *Fluorine, *Metamorphic rocks, *Groundwater, Surface waters, Alkaline water, Water circulation, Geology, Temperature, Chemical analysis, Sampling, Frequency, Mapping.

Identifiers: *Czechoslovakia, Western Moravia.

In the regionally metamorphosed skarns of Western Moravia, the main carriers of fluorine are micas, containing 0.4 - 4.2 weight per cent of fluorine, and common hornblende, with fluorine contents ranging from 1.13 up to 1.5 weight percent. In the pyroxene skarns and acid crystalline schists of the skarn mantle, the fluorine contents vary approximately around the value of 0.1 percent. A considerable share of the fluorine contained now in the skarns was carried there along with water, alkalis and other mobile components in the course of their regional metamorphism. Amphiboles of the West-Moravian amphibolites are considerably poorer in fluorine, which emphasizes the genetic differences between the skarns and amphibolites. (Gabriel-USGS) W69-10123

ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS,

Institut Prirodnoi Gazy, Moscow (USSR).

Ye. Ya. Gavrilov, V. N. Korsenshteyn, Yu. A.

Spevak, G. I. Teplynskiy, and A. S. Filin.

Transl from Geokhimiya, USSR, No 1, p 118-121, 1968. Published by Geochem Soc. Geochim Int, Vol 5, No 1, p 89-92, 1968. 4 p, 4 fig, 1 tab.

Descriptors: *Groundwater, *Aquifers, *Oil fields, *Gases, *Argon, Atmosphere, Water circulation, Sampling, Mapping, Meteoric water, Structural geology, Spectroscopy.

Identifiers: *USSR, Caucasus.

Composition of gases dissolved in groundwaters and hydrocarbon deposits of the Stavropol' arch and the Tersk-Caspian frontal downwarp were investigated by means of isotopic analysis. The amount of Ar40 in excess of that derived from the atmosphere may be different in petroleum gases and in gas dissolved in groundwater associated with petroleum deposits. Free gases, gases associated with petroleum, and gases dissolved in groundwaters may be strongly enriched in radiogenic argon. Patterns of excess Ar-40 values can show direction of movement of sources of groundwater. (Gabriel-USGS) W69-10124

DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER,

Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.

K. M. Khaylov.

Transl from Geokhimiya, USSR, No 5, p 595-603, 1968. Published by Geochemical Society. Geochim Int, Vol 5, No 3, p 497-503, 1968. 7 p, 3 fig, 17 ref.

Descriptors: *Organic compounds, *Microbiology, *Molecular structure, *Dissolved solids, *Sea water, Analytical techniques, Gels, Absorption, Humic acids, Proteins, Peptides, Amino acids, Humus, Dehydration.

Identifiers: *USSR, Kola Peninsula.

A method is presented for the emulsion-extraction of high molecular weight compounds from sea water. Fractionation of the extract on the basis of molecular weights is conducted by gel filtration on Sephadex. The compounds separated generally have molecular weights up to 200,000 and some of the material is adsorbed, indicating the presence of aromatic groups. The properties of the compounds are not the same as those of humic substances from soils or rivers. The macromolecules may dehydrate to form particulate matter in the sea. (Gabriel-USGS) W69-10125

ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES,

Vsesoyuznyi Nauchno-Issledovatel'skii Institut Neftekhimicheskikh Protessov, Moscow (USSR).

V. L. Mekhtiyeva, and R. G. Pankina.

Transl from Geokhimiya, USSR, No 6, p 739-742, 1968. Published by Geochemical Society. Geochim Int, Vol 5, No 3, p 624-627, 1968. 4 p, 1 tab, 7 ref.

Descriptors: *Sulfur, *Stable isotopes, Aquatic plants, *Dissolved solids, *Sulfates, *Sea water, Organic compounds, Salinity, Amino acids, Bacteria, Chemical analysis, Sedimentation.

Identifiers: *USSR, Black Sea.

The isotopic composition of sulfur in 15 aquatic plants was investigated on the basis of samples taken from the Uchinsk reservoir (4 plants), Moscow River (4 plants), and Golubaya Bay of the Black Sea (7 plants), and compared with that of sulfate dissolved in the same waters. The sulfur of the marine plants cannot be the sole source of organic sulfur in marine sediments. (Gabriel-USGS) W69-10133

A TABLE FOR CONVERTING pH TO HYDROGEN ION CONCENTRATION (H⁺) OVER THE RANGE 5-9,

Civil Aeromedical Inst., Oklahoma City, Okla.

Vincent Fiorica.

Available from the Clearinghouse as AD-688 120, for \$3.00 in paper copy, 0.65 in microfiche.

Federal Aviation Admin, Aviation Medical Report, AM 68123, 32 p, Oct 1968. 7 ref.

Descriptors: *Hydrogen ion concentration, Water chemistry, Physiological ecology, Digital computers, Data collections, Data processing.
Identifiers: *Conversion tables.

Recent developments in physiology make utilization of hydrogen-ion concentrations more appropriate than the conventionally used pH. With increasing use of expressions of concentration, more frequent interconversion between the two systems of notation will be required. This report presents tables, prepared from photographic reproduction of computer print-outs, of hydrogen-ion concentrations (in nanno-equivalents/liter expressed to five significant digits) for arguments of pH between 5 and 9 in increments of 0.001 unit. (Eichhorn-Wis)
W69-10148

OCCURRENCE OF SULFATE AND NITRATE IN RAINFALL,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 05B.
W69-10153

RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA,
Alaska Univ., College.
Paul E. Heilman.
Ecology, Vol 49, No 2, p 331-336, Early Spring 1968. 1 fig, 5 tab, 10 ref.

Descriptors: *Nutrients, *Phosphorus, *Cations, *Bogs, *Alaska, Manganese, Carbon radioisotopes, Radioactive dating, Trace elements, Permafrost, Radioecology, Forests, Nitrogen, Potassium, Calcium, Magnesium.
Identifiers: *Nutrient availability, *Forest succession, *Bog formation, *Picea mariana*, Sphagnum, Site index, Black spruce, Zinc, Spruce-sphagnum, Foliar concentrations.

The decrease in site index of black spruce, *Picea mariana*, was paralleled by a lower foliar concentration of nitrogen, phosphorus, and potassium. The least concentration of nutrients was found in trees supported by sphagnum peat over permafrost. Radiocarbon dating indicated that a 41-71 centimeter layer of sphagnum peat, weighing 270,000-510,000 kilograms/hectare, had accumulated in less than 185 years. The average annual increase in thickness of peat deposits was estimated between 0.25 and 0.38 centimeters. The average annual increment of organic matter on oven-dry basis varied between 1,500 and 2,800 kilograms/hectare. (Wilde-Wis)
W69-10172

CHANGE IN DISTRIBUTION AND AVAILABILITY OF NITROGEN WITH FOREST SUCCESSION ON NORTH SLOPES IN INTERIOR ALASKA,
Alaska Univ., College.
Paul E. Heilman.
Ecology, Vol 47, No 5, p 825-831, Late Summer 1966. 5 fig, 2 tab, 11 ref.

Descriptors: *Nitrogen, *Forests, *Alaska, *Cycling nutrients, Burning, Permafrost, Ecosystems, Forest management, Forest soils.
Identifiers: *Forest succession, *Picea mariana*, *Betula papyrifera*, Sphagnum, Fairbanks (Alaska), Birch-spruce ecosystems, Soil evolution, Black spruce, Ratio (C/N), Nutrient deficiencies, Burning effects.

Encroachment of sphagnum species on north-facing slopes of interior Alaska decreases availability of nitrogen and converts reasonably productive birch-spruce ecosystems into raised peat bogs supporting non-merchantable black spruce. The insu-

lating effect of sphagnum induces rising of the permafrost which at times is only 15 inches below the surface. Burning the surface moss layer exposes nitrogen-enriched substratum, increases soil temperature, moderates acidity, and enhances availability of nutrients. (Wilde-Wis)
W69-10173

OXYGENATION OF IRON (II) IN CONTINUOUS REACTORS,

North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 05D.
W69-10293

2L. Estuaries

STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES,

Virginia Polytechnic Inst., Blacksburg, Va.
For primary bibliographic entry see Field 05B.
W69-09879

OBSERVATIONS OF GASES IN CHESAPEAKE BAY SEDIMENTS,

Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
For primary bibliographic entry see Field 02K.
W69-09900

FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY,

Smithsonian Institution, Washington, D.C.
Martin A. Buzas.
Limnol and Oceanogr, Vol 14, No 3, p 411-422, May 1969. 12 p, 10 fig, 6 tab, 18 ref.

Descriptors: *Plankton, *Aquatic microorganisms, *Estuaries, *Maryland, *Estuarine environment, *Biology, Rivers, Sampling, Water temperature, Salinity, Oxygen, Chlorophyll, Statistical methods, Food abundance, Nutrients, Marine animals, Stations, Parametric hydrology.
Identifiers: Foraminifera, Choptank River.

Foraminiferal species densities (*Elphidium clavatum*, *Ammobaculites exiguus* and *Ammonia beccarii*) in the Choptank River estuary of Maryland were investigated by a detailed analysis of samples collected for 1 yr at 3 selected stations. Each station was sampled monthly for foraminiferal density, temperature, salinity, oxygen and chlorophyll contents. A general multiple regression-analysis model containing parameters for environmental variables, station differences, overall periodic differences, and the interaction of stations was statistically compared to several more restricted models. All 3 species exhibit periodicity, and for each species the periodicity is different at the 3 stations. The relatively large values of the regression coefficients for the chlorophyll suggest that the amount and kind of available food is important in determining species densities. (Gabriel-USGS)
W69-09901

MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING BRINES, THE SABKHA, TRUCIAL COAST, ARABIAN GULF,

California Univ., Riverside.
Godfrey P. Butler.
J Sediment Petrol, Vol 39, No 1, p 70-89, Mar 1969. 20 p, 8 fig, 2 tab, 31 ref.

Descriptors: *Deposition (Sediments), *Halides, *Geochemistry, *Brines, Water chemistry, Chemical analysis, Geology, Anhydrite, Gypsum, Dolomite, Sulfates, Carbonates, Pleistocene rocks, Recent epoch, Magnesium, Calcium, Temperature, Climates.
Identifiers: *Arabian Gulf, *Evaporite deposition.

Evaporite deposition and geochemistry of coexisting brines on the Trucial Coast of the Arabian Gulf was investigated on the basis of field studies and analysis of 260 interstitial brine samples. The brines and diagenetic evaporate minerals (aragonite, gypsum, halite, anhydrite) show zonation based on the frequency of periodic flooding by sea waters. The present elevation of evaporite development in the Sabkha is determined by the level of flood water above the level of high tide. Most of the anhydrite in the Sabkha is of secondary origin. The Mg/Ca balance of evaporites is controlled by both evaporation and dolomitization. Three major diagenetic facies occur in the Sabkha. The similarity between the stratigraphy and mineralogy of some Ordovician, Silurian, Pennsylvanian, and Jurassic sequences in the Sabkha suggests that evaporites of supratidal origin may be more common in older evaporite rocks than previously realized. (Gabriel-USGS)
W69-09906

ARAGONITE-CEMENTED SANDSTONE FROM OUTER CONTINENTAL SHELF OFF DELAWARE BAY: SUBMARINE LITHIFICATION MECHANISM YEILDS PRODUCT RESEMBLING BEACHROCK,

Bell Telephone Labs., Inc., Chester, N.J.; Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Geology; and Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.
R. C. Allen, E. Gavish, G. M. Friedman, and J. E. Sanders.
J Sediment Petrol, Vol 39, No 1, p 136-149, Mar 1969. 14 p, 10 fig, 3 tab, 41 ref.

Descriptors: *Lithification, *Sandstones, *Continental shelf, *Atlantic Ocean, Algae, Organic matter, Climates, Tropical regions, Marine animals, Carbon, Methane, Sea level, Marshes, Salinity, Radioactivity, Microorganisms, Geochemistry, Diagenesis.
Identifiers: Delaware Bay shelf, Submarine lithification.

A shaly sandstone containing a modern microfauna recovered from the outer shelf off Delaware Bay (79 m depth) was cemented by cryptocrystalline and fibrous aragonite and other constituents. The fossils in the sandstone are of species living in cooler water than that off the present New Jersey coast. The textural relationships of the aragonite cement and algae borings in the sandstone are identical with those of many modern beachrocks. (Gabriel-USGS)
W69-09908

NUMERICAL SIMULATION OF WAVE-CREST MOVEMENT IN RIVERS AND ESTUARIES,

Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W69-09919

INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS,

Stanford Univ., Calif. Dept. of Mineral Engineering; and Stanford Univ., Calif. Dept. of Geology.
For primary bibliographic entry see Field 07B.
W69-09932

THORIUM ISOTOPES (Th-230, Th-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS,

For primary bibliographic entry see Field 02K.
W69-10121

A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND,

Marine Lab., Aberdeen (Scotland); and Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.

I. E. Baird, and R. G. Wetzel.

Field 02—WATER CYCLE

Group 21—Estuaries

Limnology and Oceanography, Vol 13, No 2, p 379-382, Apr 1968. 1 fig, 2 tab, 4 ref. AEC AT (11-1)1599, COO-1599-4.

Descriptors: *Benthic flora, *Diatoms, *Carbon radioisotopes, *Sands, *Radioactivity, Epilimnion, Sampling, Sea water, Background radiation, Particle size, Waves (Water).

Identifiers: Production rates, Scotland, Firemore Bay (Loch Ewe), Phaeodactylum, Shell gravel, Gas phase, Geiger-Mueller counter, Loch Ewe (Scotland).

An ecology study of Firemore Bay, a sandy bay in Loch Ewe off the coast of northwestern Scotland, led to the development of methods for measurement of production rates by benthic diatoms. The methods described for estimating these rates of the epilithic sand flora apply to those littoral areas where effectively all the flora are attached to the sand grains and where the natural disturbance of the sand surface by wave action permits mixing of the samples before and after incubation. The effect of the sand disturbance during incubation was tested by shaking samples every 15 minutes for four hours; these gave slightly lower and more variable results than did unshaken samples. Thus, movement of the sand does not appear to enhance production rates. Within the limits of error described, radioassay in gas phase can be replaced by the simpler end-window Geiger-Mueller method. Use of an ordinary culture for calibration of this method does not give significantly different results from those using a true benthic diatom. Consequently, this method provides a simple way of calibrating the normal instrumentation used for carbon-14 determinations to estimate production rates by attached diatom populations of sandy beaches. (Jones-Wis)

W69-10150

THE HABITAT OF LEUCOTHRIX MUCOR, A WIDESPREAD MARINE MICROORGANISM, Indiana Univ., Bloomington. Dept. of Bacteriology. For primary bibliographic entry see Field 05C.

W69-10161

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER, Forest Service (USDA), Washington, D.C. Div. of Watershed, Recreation, and Range Research. Herbert C. Storey, and Irvin C. Reigner.

Proc Soc Amer Foresters Meeting (1966), p 143-146, 1967.

Descriptors: *Watershed Management, *Water yield improvement, *Water supply, *Water demand, *Vegetation effects, Elasticity of supply, Water sources, Consumptive use, Evapotranspiration, Rainfall-runoff relationships, Droughts, Water distribution (Applied).

Rainfall and runoff across the U.S.A. is sufficient to meet the water demands in the foreseeable future, but both supplies and demands are poorly distributed. More water can be made available at low cost by increasing the yield of water sources now in use. A significant contribution can be made by manipulating the vegetation on wildlands. Estimates of increased yield are presented region by region with general recommendations on how to achieve them.

W69-10004

ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES, 1967, Bureau of Reclamation, Denver, Colo. P. M. Turner.

Bur Reclam, Water Conserv Br Div Res Rep No WC-48, Oct 1968. 38 p, 1 fig, 15 tab, 21 ref, append.

Descriptors: *Phreatophytes, *Evapotranspiration, *Evapotranspiration control, Water yield improvement, Water resources, Water conservation, Semiarid climates, Lysimeters, Herbicides, Surfactants, Chemcontrol, Tamarisk.

Identifiers: Bureau of Reclamation phreatophyte studies.

Bureau of Reclamation activities on phreatophyte research and control are described. Regional research contracts have been negotiated with the Universities of Arizona and Nevada. At Denver saltcedar plants are greenhouse- and nursery-cultured and used as test specimens for foliar-applied herbicides. Herbicide evaluation plots were established along the Arkansas River near North Avondale, Colo. Helicopter herbicide spraying was performed on about 250 acres of saltcedar around Rye Patch Reservoir, and about 100 acres were sprayed by fixedwing aircraft by Pershing County Water Conservation District. About 16,000 acres of phreatophytes were cleared in the Colorado Indian Reservation near Parker, Ariz., by lessees. Phreatophytes were controlled by tree crusher, root plow, cutter dozer, and spraying on about 12,700 acres along the Pecos River in New Mexico. Phreatophyte vegetation along the Arkansas River between Pueblo, Colo., and Great Bend, Kans., has been surveyed by Colorado State University and Fort Hays Kansas State College under Region 7 contract. (Knapp-USGS)

W69-10126

3D. Conservation in Domestic and Municipal Use

LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK METROPOLITAN REGION,

Rutgers - The State Univ., New Brunswick, N.J.; Barnard Coll., New York; and Columbia Univ., New York.

For primary bibliographic entry see Field 06A.

W69-10023

FUTURE SUPPLIES OF WATER FOR DOMESTIC USE.

For primary bibliographic entry see Field 06E.

W69-10039

3E. Conservation in Industry

WATER USE IN THE PETROLEUM AND NATURAL GAS INDUSTRIES,

Bureau of Mines, Washington, D.C. Div. of Statistics.

For primary bibliographic entry see Field 06D.

W69-09944

3F. Conservation in Agriculture

STUDY OF IRRIGATION BY SPRINKLING (FRENCH),

Department of Agronomical Sciences of the State, Gembloux (Belgium).

J. Dendas, and A. Bentsz.

La Trib du Cebedeo. Vol 22, No 305, p 191-195, Apr 1969. 5 p, 1 fig, 6 tab, 3 ref.

Descriptors: *Irrigation practices, *Spraying, *Agriculture, Agricultural engineering, Vegetable crops, Evapotranspiration, Evaporation, Lysimeters, Water loss, Temperature, Humidity, Statistical methods, Water utilization, Beans.

Identifiers: Irrigation by sprinkling.

On the basis of the Turc formula and the application of statistical techniques developed by Bumbel,

the value of irrigation by sprinkling was investigated. Sprinkling was carried out from 1951 to 1965 on sugar beet and vegetable crops. The discussion includes: (1) terminology and definitions; (2) land irrigation trials; (3) sugar beets irrigation trials; (4) vegetable irrigation trial; and (5) the conclusions. The application of a hydraulic potential deficit concept and by sprinkling lead to a reliable evaluation of the water supply and to an increase in production of vegetables and sugar beets. (Gabriel-USGS)

W69-09903

DYNAMICS OF OBJECTS IRRIGATORY SYSTEMS REGULATION,

Frunze Polytechnic Inst. (USSR).

E. E. Makovsky.

IFAC, Haifa Symp, Comput Contr Nat Resources, Public Util, p 2-16, Sept 1967. 16 p, 1 tab, 1 fig, 4 ref.

Descriptors: *Mathematical models, *Irrigation efficiency, *Optimization, *Water supply, *Unsteady flow, Hydraulic design, Analogue computers, Systems analysis, Canal construction, Automatic control, Water conveyance.

The application of mathematical techniques for solving irrigation water supply problems in regions with insufficient water reserve was discussed. The objective of the study was to define optimal systems for connecting water consumers with the irrigation system and the possibility of providing them with water irrespective of its flow and velocity in the system. Linear approximation techniques were employed. The appropriate analytical methods of approximate description in general terms of functional dependence of transient characteristics upon hydraulic canal parameters and hydrotechnical constructions were of particular importance, because these methods secured the required precision. Discussed were possibilities of using analogue computers for solving problems of physically modelling cascade water regulation system. (Thiuri-Cornell)

W69-10025

ARKANSAS IRRIGATION, DRAINAGE AND WATERSHED IMPROVEMENT DISTRICT ACT OF 1949.

For primary bibliographic entry see Field 06E.

W69-10065

AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER,

Nevada Univ., Reno. Coll. of Engineering.

Richard G. Orcutt.

Engineering Report No. 7, Center for Water Resources Research, Desert Research Institute, University of Nevada, Oct 1967. 123 p, 17 fig, 12 tab, 3 append, 47 ref.

Descriptors: *Irrigation, *Water types, *Model studies, Computer programs, Golf courses, Parks.

Identifiers: *Las Vegas (Nev), *Hele-Shaw Model, *Aquifer storage.

A generalized computer program for computing the production costs of systems utilizing aquifer storage for irrigation purposes with reclaimed waste water was developed. A sensitivity analysis was performed by observing the effects on varying the values of input parameters, which represented decision variables and constants with uncertain values, upon the cost of producing reclaimed water. Preliminary feasibility studies were conducted in Las Vegas, Nevada. The model enables the analyst to rapidly determine the effect of varying about forty input parameters on the cost of water production. An appendix on 'The Design of A Hele-Shaw Model', from a thesis by Donald L. Clark is included. The computer program (Fortran language) is also included. (Grossman-Rutgers)

W69-10187

IRRIGATION WITH RESTRAINTS ON LAND AND WATER RESOURCES,
Kansas State Univ., Manhattan. Dept. of Economics.
Wilfred H. Pine, and Amar S. Sirohi.
Land Economics, Vol 45, No 2, p 285-287, May 1969. 3 p, 1 tab, 2 ref.

Descriptors: *Irrigation efficiency, *Irrigation permits, *Mathematical studies, Subsurface waters. Identifiers: *Kansas, *Production functions.

In Kansas a permit is required to use water for other purposes than domestic uses, so that priorities may be implemented in case of shortages. The holder of the permit is allowed to withdraw a quantity equal to or in excess of the economic optimum. The cost of withdrawal and application of groundwater for irrigation are the major restraints. In maximizing profits water is applied to land until the product from the last unit of water exceeds the costs of that unit of water. If the water supply is exhausted by the optimal rate, the irrigator and society must decide on the quantity of water to be used. This report shows that with prevailing costs and prices and conditions of limited total water, optimal irrigation would call for about twice as much land with one-half as much water per acre as compared with optimal irrigation with no limitation on water. (Grossman-Rutgers)
W69-10189

WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA.
North Carolina Water Resources Research Inst., Raleigh.

David H. Howells, (Editor). WRRI-UNC Report No. 27, March 14, 1969, 31p. OWRR Contract 14-01-0001-1853.

Descriptors: *Agriculture, *Drainage, *Irrigation, *Pesticides, *Fertilizers, Wildlife management, *Animal wastes, Water quality, Groundwater recharge. Identifiers: North Carolina.

The objectives of this workshop were to: explore and characterize problems associated with land drainage, irrigation, agricultural chemicals, animal and human wastes, and farm water supplies; identify and define specific research needs directed to recognized problems; and suggest priorities among identified research needs. Participants included University research and extension staff, representatives of state and federal agencies and private industry, county extension chairmen and farmers. Their fields of interest encompassed agriculture, forestry, planning, water resource management, public health and conservation. While the initial workshop directed its attention to the Coastal Region, this report is generally applicable to the state as a whole. Copies of the report draft were circulated to all County Extension Chairmen throughout the state. Comments were received from 13 additional counties in the Coastal Region, 16 in the Piedmont and 6 in the Mountain Region, and are summarized in this report. There was general agreement with the initial report except for minor emphasis on drainage problems outside the Coastal Region. Each participant was asked to assign a numerical priority to the research needs identified during the workshop. Those with an average in excess of 2.5 on the 1 to 5 scale were dropped and the remaining needs listed in order of priority. Additional suggestions concerning research needs were added during review of the draft and these were listed separately. This report will be used by the Institute as a guide to the development of its research program in the field of agricultural water use. Its limitations are recognized, however, and every encouragement is given to the flow of new ideas of promise which escaped recognition at this time.
W69-10294

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

BASIC DATA REPORT NO 3 FOR RESEARCH ON FLOOD FREQUENCY FOR SMALL DRAINAGE AREAS,
Geological Survey, Jackson, Miss.
For primary bibliographic entry see Field 02E.
W69-09895

FLOODPLAIN INFORMATION, FIVE MILE CREEK, METROPOLITAN BIRMINGHAM, ALABAMA.

Corps of Engineers, Mobile, Ala.

Corps Eng Floodplain Rep, June 1969. 33 p, 7 fig, 16 plate, 10 tab.

Descriptors: *Floods, *Flood damage, *Alabama, *Floodplains, Flood control, Non-structural alternatives, Maximum probable flood. Identifiers: Birmingham (Ala), Standard project flood, Intermediate regional flood.

Flooding of Metropolitan Birmingham, Alabama is described in a report of floodplain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of floodplain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-09896

FLOODPLAIN INFORMATION, SWEETWATER, JACKSON, CAMP, BEAVER RUN, AND BROMOLOW CREEKS, METROPOLITAN ATLANTA, GEORGIA.

Corps of Engineers, Savannah, Ga.

Corps Eng Floodplain Rep, June 1969. 70 p, 34 fig, 53 plate, 19 tab.

Descriptors: *Floods, *Flood damage, *Georgia, Floodplains, Flood control, Non-structural alternatives, Maximum probable flood. Identifiers: Atlanta (Ga), Standard project flood, Intermediate regional flood.

Flooding of Metropolitan Atlanta, Georgia is described in a report of floodplain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of floodplain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-09897

FLOODPLAIN INFORMATION, FOURCHE CREEK AND TRIBUTARIES, LITTLE ROCK, ARKANSAS - PART I.

Corps of Engineers, Little Rock, Ark.

Corps Eng Floodplain Rep, June 1969. 42 p, 22 fig, 35 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Arkansas, Floodplains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.

Identifiers: Little Rock (Ark), Standard project flood, Intermediate regional flood.

Flooding of Little Rock, Arkansas is described in a report of floodplain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of floodplain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-09898

HYDROLOGY OF FOREST LANDS AND RANGELANDS,

Forest Service (USDA), Washington, D.C.; and Agricultural Research Service, Washington, D.C. For primary bibliographic entry see Field 02A.
W69-10002

SEDIMENT--ITS CONSEQUENCES AND CONTROL,

Agricultural Research Service, Washington, D.C.; and Forest Service (USDA), Washington, D.C. For primary bibliographic entry see Field 02J.
W69-10003

PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS,

Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center. For primary bibliographic entry see Field 06A.
W69-10011

CONJUNCTIVE USE OF GROUND AND SURFACE WATERS,

California State Dept. of Water Resources, Los Angeles.

For primary bibliographic entry see Field 06A.
W69-10012

DAMS.

For primary bibliographic entry see Field 06E.
W69-10027

CANALS AND WATERWAYS, RIVERS, LAKES, STREAMS.

For primary bibliographic entry see Field 06E.
W69-10043

ILLINOIS WATERWAY.

For primary bibliographic entry see Field 06E.
W69-10044

STATE AID IN FLOOD CONTROL; MUNICIPAL-FEDERAL FLOOD CONTROL PROJECTS.

For primary bibliographic entry see Field 06E.
W69-10048

WATER SERVICE DISTRICT.

For primary bibliographic entry see Field 06E.
W69-10049

BRIDGES.

For primary bibliographic entry see Field 06E.
W69-10056

WATER SUPPLY, DRAINAGE AND FLOOD CONTROL.

For primary bibliographic entry see Field 06E.
W69-10057

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

WATER DRAINAGE AND LEVEE DISTRICTS.

For primary bibliographic entry see Field 06E.

W69-10061

WATER DRAINAGE AND LEVEE DISTRICTS.

For primary bibliographic entry see Field 06E.

W69-10062

WATER DRAINAGE AND LEVEE DISTRICTS.

For primary bibliographic entry see Field 06E.

W69-10063

WATER DRAINAGE AND LEVEE DISTRICTS.

For primary bibliographic entry see Field 06E.

W69-10064

ARKANSAS IRRIGATION, DRAINAGE AND WATERSHED IMPROVEMENT DISTRICT ACT OF 1949.

For primary bibliographic entry see Field 06E.

W69-10065

IMPROVEMENT DISTRICTS OF RIVER WATER - DRAINAGE AND LEVEE DISTRICTS.

For primary bibliographic entry see Field 06E.

W69-10066

LEVEE AND DRAINAGE DISTRICTS.

For primary bibliographic entry see Field 06E.

W69-10076

FLOOD PLAIN INFORMATION, MISSISSIPPI RIVER AT NATCHEZ, MISSISSIPPI.

Corps of Engineers, Vicksburg, Miss.

Corps Eng Flood Plain Rep, June 1969. 37 p, 20 fig, 9 plate, 5 tab.

Descriptors: *Floods, *Flood damage, *Mississippi River, *Mississippi, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.

Identifiers: Natchez (Miss), Standard project flood, Intermediate regional flood.

Flooding of the Mississippi River at Natchez, Mississippi is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study, and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)

W69-10086

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN THE DISTRICT OF COLUMBIA.

Corps of Engineers, Baltimore, Md. North Atlantic Div.

Corps Eng Water Resources Develop Rep, Jan 1, 1969. 23 p, 1 fig, 1 plate, 7 photo, index.

Descriptors: *Water management (Applied), *District of Columbia, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.

Identifiers: U.S. Army Corps of Engineers projects (D.C.).

U.S. Army Corps of Engineers water resources development projects in the District of Columbia are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for

initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)

W69-10102

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN MARYLAND.

Corps of Engineers, Baltimore, Md. North Atlantic Div.

Corps Eng Water Resources Develop Rep, Jan 1, 1969. 80 p, 3 fig, 48 photo, 2 map, index.

Descriptors: *Water management (Applied), *Maryland, *Water resources development, Navigation, River basin development, Flood control, Multiple purpose projects, Hydroelectric power, Dams, River training.

Identifiers: U.S. Army Corps of Engineers projects (Maryland).

U.S. Army Corps of Engineers water resources development projects in Maryland are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)

W69-10103

SHORT-RANGE FORECASTING OF LOWLAND-RIVER RUNOFF,

Gidrometeorologicheskii Institut, Leningrad (USSR).

For primary bibliographic entry see Field 02A.

W69-10146

DRAINS, CULVERTS, AND BRIDGES AS PART OF THE STATE HIGHWAY.

Ind Ann Stat sec 36-110 (1949).

Descriptors: *Indiana, *Drains, *Culverts, *Bridges, Legislation, Legal aspects, Contracts, Highways, Bridge construction.

All drains, culverts, and bridges on any state highway will be considered part of the state highway. All bridges having a span of over twenty feet may be let as a separate contract; the procedure is the same as for letting contracts for state highways. (Keith-Fla)

W69-10179

EMINENT DOMAIN.

Ind Ann Stat sec 36-303 (1949).

Descriptors: *Indiana, *Drainage, *Highways, *Eminent domain, Bridges, Culverts, Legislation, Land tenure, Right-of-way, Construction, Administrative agencies, Public lands.

In all cases of a highway constructed under the provisions of this act, the right of way therefor, or any required drainage courses, or approaches, or land necessary to build a bridge or culvert, shall be acquired by the county, either by donation by the owners of the land through which such highway shall pass or by agreement between such owner and the board of commissioners of such county, or through the exercise by such board of commissioners of the power of eminent domain, or through the public acquisition of such property as is necessary in the same manner as is now provided by law for the establishment, opening and widening of public highways, and in any event the entire cost of such right of way shall be paid for by the county. (Heckerling-Fla)

W69-10185

ERECTION AND INSPECTION OF DAMS.

NH Rev Stat Ann secs 482:3-482:15 (1968).

Descriptors: *New Hampshire, *Dam construction, *Administrative agencies, *Dams, Legislation, Water policy, Legal aspects, Financing, Regulation, Jurisdiction, Dam design, Damsites, Administration, Permits, Water rights, Administrative costs, Decision making, Standards, Water resources development, Inspection.

Identifiers: Penalties (Civil).

Construction must not begin on any dam until ten days have elapsed after the filing of a statement showing the height of the proposed dam and its location with the Water Resources Board. The Board may require the owner or applicant to produce plans and specifications for the dam which must be approved by the board if, initially, there is concern that an improperly constructed dam would be a menace to public safety. The Board may designate an inspector to supervise the construction under such plans. The Board has authority to issue orders requiring owners or contractors of such dams to comply with the approved plans and specifications. The Board from time to time causes all dams in the state to be inspected to protect public safety and may require such repairs as are deemed necessary. Penalties, injunctions, and appellate relief are procedures under which the provisions of this chapter are carried out. Expenses for examining plans and inspections of dams are paid by the dam owners and, though received by the state, are applied to the appropriation available for use by the Board. (Johnson-Fla)

W69-10223

CONNECTICUT RIVER FLOOD CONTROL COMPACT.

Vt Stat Ann Tit 10, secs 801-810 (1958), as amended, (Supp 1968).

Descriptors: *Vermont, *Flood control, *Water resources development, *Interstate compacts, State governments, Economic impact, Economics, Recreation, Social impact, Planning, Investigations, Cost analysis, Decision making, Legal aspects, Governments, Government finance, Federal government, Legislation, Water law, Administrative agencies, Political aspects, Water rights, Dams, Reservoirs, Multiple purpose projects, Water distribution (Applied), Irrigation.

The federal government's flood control act of 1936 which provided for construction of dams for flood control, irrigation, hydroelectric power, and recreation removes from the tax rolls of local governments such property as is acquired for the above purpose. The compact's signatories, Connecticut, Massachusetts, New Hampshire, and Vermont, recognize that it is in their general welfare to join together to promote not only cooperation with the federal government, but also to protect their own local interests in such affairs. The Connecticut River Valley Flood Control Commission is established with the general powers necessary for the making of studies aimed at the development of a comprehensive plan for flood control and utilization of water resources. Construction sights for a number of dams are agreed to by the compact members. Connecticut and Massachusetts agree to compensate other signatories for economic losses and damages occasioned by such dams or reservoirs as determined by the commission. An arbitration procedure is prescribed in the event that the commissioners cannot agree on the amount of compensation. The compact, in order to become effective, must be approved by each signatory state and the Congress of the United States. (Johnson-Fla)

W69-10224

DRAINAGE OF LOW LANDS.

Vt Stat Ann Tit 10, secs 501 thru 515 (1958), as amended, (Supp 1968).

Control of Water on the Surface—Group 4A

Descriptors: *Vermont, *Drainage, *Administrative agencies, *Jurisdiction, Surface drainage, Ditches, Drainage programs, Drainage systems, Land management, Water law, Legal aspects, Legislation, Local governments, Farm management, Drainage practices, Adjudication procedure, Social aspects, Political aspects, Damages, Costs, Watercourses (Legal).
W69-10232

Owners of low or swamp lands may drain them for purposes of cultivation, but when a dispute between landowners over the opening of a ditch or water course arises, the selectmen of the town must be notified in writing in order that they may conduct an investigation. At the hearing on the dispute selectmen may take such action as deemed necessary, including apportioning of costs of such ditch among the parties. When owners refuse to open ditches across their property and same appears necessary and in the public interests, the selectmen may allow parties who would be benefited by the ditch to open one across the land of such owners. Damages may be claimed by the landowner through whose land such ditch is constructed. Such damages will be paid by the parties benefited by the ditch. Cleaning and repairing of the ditches are the responsibilities of the landowner. Appeal from decisions of the selectmen may be made to the county court; such court may accept or reject the award or appoint a commission of three disinterested freeholders who will examine the premises and make recommendations to the court. (Johnson-Fla)
W69-10225

RUBIN V W. H. HINMAN, INC. (STATE DRAINAGE EASEMENTS).
253 A2d 708-712 (Me 1969).

Descriptors: *Maine, *Drainage, *Easements, *Eminent domain, Condemnation, Legal aspects, Right-of-way, Judicial decisions, Drainage practices, Local governments, Highways, Public benefits, Administrative agencies.
Identifiers: *Drainage easements.

Plaintiff brought an action for trespass because defendant, road contractor, entered upon his property without permission, dug a trench, and laid a pipe therein. The defendant was justified in such action only if the State Highway Commission had lawfully taken a drainage easement over the plaintiff's property for highway purposes. The issue was whether an agreement between the municipality and the State Highway Commission was invalid. The agreement was to the effect that this property would revert to municipal control. The court held that the state may validly exercise the power of eminent domain if the property was taken for a public purpose whether or not it is in effect being done for another level of government. Defendant's motion for summary judgment was granted and the taking of the drainage easement approved. (Johnson-Fla)
W69-10226

DOCKS.

Iowa Code Ann secs 384.1-384.4 (1949), as amended, (Supp 1969).

Descriptors: *Docks, *Construction, *City planning, *Iowa, Condemnation, Taxes, Tax rate, Navigable rivers, Channels, Wharves, Railroads, Public utilities, Local governments, Legislation, Contracts, Cities, Administrative agencies, Easements, Planning.

Cities on navigable waterways may establish a department of public docks. This board, created to supervise the department, shall prepare a general plan of harbor improvement. The board is empowered to purchase or condemn needed property and has exclusive control over municipal wharf property. It has authority over those streets necessary to further the general plan and control over the harbor and water front as is not inconsistent with the laws of the United States. The board may make ordinances for the collection of reasonable

fees for the use of such municipal facilities. Construction contracts must be let by competitive bids. All costs of construction will be met by special taxes or bonds approved by the voters. All state regulation pertaining to the operation of railroads or public utilities shall apply to this department. (Darragh-Fla)
W69-10232

LEVEE AND DRAINAGE DISTRICTS.

Iowa Code Ann, secs 455.56, 455.70 to 455.72, as amended, (Supp 1969).

Descriptors: *Iowa, *Drainage districts, *Drainage systems, *Assessments, Legislation, Administration, Administrative agencies, Regulation, Ditches, Drainage programs, Classification, Cost allocation, Cost-benefit analysis, Cost sharing, Benefits, Legal aspects, Drains.

When adopted, a classification of land for drainage purposes remains the basis for future assessments unless revised by reclassification procedures. Classifications are apportioned when parcels are divided, which may be by agreement of the parties, by an appointed commission, or by the county auditor. After establishment of a drainage district, any land owner who was assessed but who is not directly on the ditch, drain, or watercourse, who desires to connect across another's land, but who cannot agree on terms and conditions for connection, may petition for a subdistrict under proceedings established for original districts. Such connecting drain or ditch is presumed to be desirable as if a part of the original improvement and becomes a part of that improvement under the board's control. If assessments are inequitable because there has been a change in character of lands or because improvements or extensions have become necessary, the board may order a reclassification of all or part of the lands. (Doublerley-Fla)
W69-10233

REGIONAL WATER DISTRIBUTION DISTRICT ACT.

Ark Stat Ann secs 21-1401 thru 21-1415 (1968).

Descriptors: *Arkansas, *Water districts, *Reservoir storage, *Water distribution (Applied), Legislation, Administration, Administrative agencies, Dams, Reservoirs, Retention reservoirs, Multiple-purpose reservoirs, Water storage, Water supply, Water purification, Retention, Water management (Applied), Distribution, Water contracts, Water rights, Water conveyance, Water delivery, Water utilization, Water policy, Regulation.

Public, nonprofit regional water districts may be organized to acquire and store water in reservoirs behind multi-purpose government dams, to purify and process water, and to distribute and transport such water to users. When a dam is authorized for construction, 100 or more voters owning land may petition the circuit court to establish a water district. The Soil and Water Conservation Commission investigates the proposal and files a report of its findings with the court. After a hearing, the circuit court orders the establishment of the district. The district is administered by a board of directors composed of three voters elected from each county in the district. The district is vested with corporate powers, and it may acquire title to stored water, transport and sell such water, provide necessary facilities, and aid customers in preparing facilities for water use. The district may fix and collect fees for services and has the power of eminent domain. The district is tax exempt, as is interest on all instruments of indebtedness. (Doublerley-Fla)
W69-10234

WHITE RIVER NAVIGATION DISTRICT COMMISSION.

Ark Stat Ann secs 21-1601 thru 21-1611 (1968).

Descriptors: *Arkansas, *Rivers and Harbors Act, *Navigation, *Water resources development, Rivers, Administration, Administrative agencies, Legislation, Navigable rivers, Tributaries, Non-consumptive use, Riparian rights, Federal government, State governments, Interagency cooperation, Financing, Assessments, Costs, Cost sharing, Condemnation.

Identifiers: River navigation districts, Federal-state cooperation.

The White River Navigation District Commission cooperates with the Army and federal agencies in the development of the White River. The Commission provides necessary lands, easements, and rights of way, holds the United States free from damages resulting from River and Harbor Act projects, and shares costs of projects when necessary. The Commission consists of five commissioners appointed by the governor from counties adjacent to the river. Provisions are made for terms, removal, vacancies, and expenses of such commissioners; time and place of meetings; and designation of a chairman. The Commission has corporate powers, may operate and construct necessary facilities, and may raise funds by charging fees for terminal use or by assessing benefits to riparian owners for re-establishment of navigation. The Commission may acquire property by purchase or by condemnation and may borrow or issue bonds for financing. (Doublerley-Fla)
W69-10235

ARKANSAS WATERWAYS COMMISSION.

Ark Stat Ann secs 21-1701 thru 21-1703 (1968).

Descriptors: *Arkansas, *Navigable waters, *Transportation, *Water management (Applied), Channels, Inland waterways, Stream improvement, Administration, Administrative agencies, Legislation, Streams, Navigable rivers, Harbors, Recreation, Non-consumptive use, Water policy, Water utilization, Regulation, Water resources development.

The Arkansas Waterways Commission is composed of seven members appointed by the governor for seven year terms. At least one member is from each of the state's five stream basin areas. Provisions are made for recommendations for appointment, filling of vacancies, and compensation. The Commission: (1) studies and coordinates efforts to develop navigable streams; (2) encourages and coordinates development of river port and harbor facilities; (3) encourages and coordinates water recreation and recommends the establishment of recreation areas and rules and regulations; (4) represents the state in matters concerning fees for water transportation services; and (5) receives grants and donations for river transportation development. (Doublerley-Fla)
W69-10236

WINYAH BAY TO SOUTH, ASHLEY RIVER AND SHIPYARD RIVER.

SC Code Ann secs 70-251 thru 70-268 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Water resources development, *Navigation, *Inland waterways, Legislation, Administrative agencies, Legal aspects, Water utilization, Oysters, Ownership of beds, Beds under water, Boundaries (Property), Riparian rights, Condemnation, Easements, Condemnation value, Jurisdiction, State jurisdiction, Water rights, United States, Rivers and Harbors Act, Land use, Damages.

The Governor and the Secretary of State may issue grants of perpetual right and easement to lands, including submerged lands, necessary to the United States for completion of the intracoastal waterway as approved by the River and Harbor Act of 1937. Lands raised by construction and maintenance of such intracoastal water are similarly granted to the federal government. Lands in private hands necessary for such project are secured for the state by

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

the State Development Board, whether by purchase, donation, or otherwise, through agreement with the owner when possible. When agreement is not possible, procedures similar to those employed in condemnation of lands for highway purposes are employed. The United States may condemn such property if it desires. The state retains jurisdiction over all properties granted for this project in all civil and criminal actions over which it would otherwise have jurisdiction. In the event lands taken under this chapter have been leased by the state Wildlife Resources Commission for cultivation of oysters, suitable replacement will be made and damages to beds outside land so taken which are caused by the project will be reimbursed by the persons causing same. (Johnson-Florida) W69-10238

DAVIS V CAHOON (DIVERSION OF NATURAL FLOW BY LOWER LANDOWNER PROHIBITED).

168 SE2d 70-74 (Ct App NC 1969).

Descriptors: *North Carolina, *Natural flow doctrine, *Diversion, *Drainage systems, Surface waters, Canals, Floodgates, Flood damage, Judicial decisions, Obstruction to flow, Relative rights, Pumping, Land tenure, Easements, Legal aspects, Tidal waters, Riparian rights, Water rights, Alteration of flow.
Identifiers: *Subservient lower estate, Upper land, Lower land.

Plaintiffs and defendants owned tracts of land which, along with other tracts, shared the West One Canal for purposes of draining their lands into the tidal waters of Juniper Bay, a natural water body. Flood gates operated automatically to close the canal whenever tidewaters in the bay became high enough to run back into the canal and flood the lands. Plaintiffs alleged that defendants changed the drainage system by placing dikes and canals on their land to concentrate drainage and by using pumps to convey the excess water in large amounts into the West One Canal. Plaintiffs alleged that when the floodgates were shut, the pumping caused flooding of plaintiffs' land, and when they were open the force of the pumped water into the canal created a dam obstructing the natural flow. On appeal from an involuntary nonsuit, the court of appeals of North Carolina held that an easement for reasonable natural drainage existed in favor of upper landowners. The court noted that although defendants could accelerate natural flow, they could not divert it. The question of acceleration or diversion was held to be for the jury, and the court granted a new trial on that ground. (Harris-Florida) W69-10239

BLOOM V WATER RESOURCES COMMISSION (RELATIVE RIGHTS OF OWNERS OF ADJACENT UPLANDS).

254 A2d 884-889 (Conn 1969).

Descriptors: *Connecticut, *Relative rights, *Riparian rights, *Permits, Legal aspects, Marinas, Navigable rivers, Administrative agencies, Regulation, High water mark, Low water mark, Boundaries (Property), Channels, Navigation, Water rights, Competing uses, Dredging, Construction, Judicial decisions, Riparian land.
Identifiers: *Littoral rights.

Plaintiffs appealed from the state water resources commission's granting of a permit to the defendant, an adjacent landowner, which authorized the construction of a marina and the dredging of a channel in front of defendant's property. Plaintiffs use their upland in connection with their oyster operation. Plaintiffs' complaint was based on the fact that the defendant's marina would prevent ingress and egress of plaintiffs' oyster boats except from one side. The court found that defendant's ownership of the adjoining upland gave him the exclusive right to dig channels and build wharves from his land to reach deep water, so long as he did not in-

terfere with free navigation. The court held in affirming the decision of the superior court that the issuance of a permit to the defendant was not an adjudicative action as to the plaintiffs such as to entitle them, as a requirement of due process, to a hearing. The permit issued the defendant gave him only those rights to which he would have been entitled at common law, and the plaintiffs' rights remained unchanged. (Keith-Florida) W69-10240

SKAFF V SIOUX CITY (UNREASONABLE DELAY IN CONDEMNATION PROCEEDINGS).

168 NW 2d 789-794 (Iowa 1969).

Descriptors: *Iowa, *Condemnation, *Cities, *Damages, Eminent domain, Flood control, Access routes, Relocation, Land tenure, Relative rights, Remedies, Judicial decisions, Condemnation value, Legal aspects, Compensation, Flood protection, Projects, Project planning, Financing.
Identifiers: Urban renewal, Unreasonable delay.

Plaintiffs owned rental property near the Floyd River, a perennial source of flood damage to the city. Defendant city determined that it was necessary to take plaintiffs' property in order to relocate the river pursuant to plans of the Floyd Flood Control Project. In 1960, the defendant notified plaintiffs that their property was within the flood control project, and subsequently negotiations were begun for acquisition of the property. Plaintiffs lost access to their property in 1962. However, defendant did not take plaintiffs' property until 1965 so that it could gain financial advantage by using urban renewal funds. In a suit for damages caused by unreasonable delay in perfecting its condemnation of plaintiffs' property, the trial court found that the city showed bad faith in protracting the proceedings which resulted in a substantial loss of rental profits to plaintiffs. On appeal by the city, the Supreme Court of Iowa affirmed the trial court's finding that the delay in perfection of condemnation occasioned by the shift from the flood control project to urban renewal was unreasonable. (Harris-Florida) W69-10241

DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.

Ky Rev Stat Ann secs 104.450-104.680 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Administrative agencies, *Flood control, Levees, Legislation, Taxes, Tax rate, Assessments, Gaging stations, Boundaries (Property), Contracts, Operating costs, Operation and maintenance, Contours, Adjudication procedure, State governments, Administration, Regulation, Costs, Leadership, Flood protection, Surveys, Structures.
Identifiers: *Flood control districts.

The Commission of Conservation of the Commonwealth of Kentucky may establish flood control districts for the purpose of maintaining and operating flood control works. Procedures for the establishment of such districts and their boundaries are set forth. Provisions are also made for the following: (1) the certification of the establishment of districts; (2) the appointment of a board of directors; (3) court action opposing the creation of a district; (4) officers and employees of the board of directors and their duties; (5) contracts for work, materials or supplies; (6) the maintenance of stream and rain gauges and scientific surveys; (7) the levy and collection of a tax for each district and the assessment of the valuation of property within the district; and (8) depreciation, operation and maintenance funds. For purposes of this act, 'flood control works' is defined. (Marsee-Florida) W69-10243

DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.

Ky Rev Stat Ann secs 104.450-104.560 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Administrative agencies, *Flood control, Legislation, Boundaries (Property), Levees, Contours, Adjudication procedures, State governments, Administration, Regulation, Leadership.
Identifiers: *Flood control districts.

The Commissioner of Conservation of the Commonwealth of Kentucky is vested with the jurisdiction and power to establish flood control districts for the purpose of maintaining and operating flood control works. The boundary line of such districts shall be determined with reference to the floodwall or levee and the contour line on the line back of such floodwall or levee. A petition signed by seventy percent of the freeholders within a proposed district shall be filed with the Commissioner of Conservation before such district may be established, and such petition shall be governed by the provisions herein. Property owners opposing the creation of a proposed district may do so in the circuit court wherein the proposed district is to be located and shall conform to the procedure here set forth. The Commissioner of Conservation shall issue a certificate of establishment of each district, and such certificate shall be final and binding upon the real property in the district. For purposes of this act 'flood control works' is defined. (Marsee-Florida) W69-10244

DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.

Ky Rev Stat Ann secs 104.570-104.680 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Administrative agencies, *Flood control, Legislation, Administration, Taxes, Tax rates, Assessments, Gaging stations, Operating costs, Contracts, Operation and maintenance, Adjudication procedure, Regulation, Leadership, State governments.
Identifiers: *Flood control districts.

The Commissioner of Conservation shall designate, in the certificate of establishment of a flood control district, the place where the office of the district shall be located. There shall be appointed a board of directors for each district the business of which shall be conducted as here set forth. The Board is charged with the following: (1) to elect a president, secretary and treasurer; (2) to govern the flood control district; (3) to adopt all necessary regulations for carrying into effect the objects for which the district was formed; (4) to recover by civil actions from any persons violating such rules and regulations; (5) to enforce by mandamus all authorized rules and regulations; (6) to have an annual audit made; (7) to employ an attorney, an engineer, and other employees; (8) to contract for work, materials and supplies; (9) to establish and maintain stream and rain gauges and surveys necessary for the purpose of the district; (10) to levy an annual tax on the property within the district; and (11) to maintain depreciation, operation and maintenance funds. Persons willfully failing to comply with regulations of the Board will be liable for damages. (Marsee-Florida) W69-10245

POWER TO ACQUIRE PIERS AND BEACHES.

Ill Ann Stat ch 24, sec 11-93-1 (Smith-Hurd 1962).

Descriptors: *Illinois, *Eminent domain, *Recreation facilities, *Cities, Legislation, Beaches, Piers, Navigable waters, Public benefits, Land tenure, Land use, Legal aspects.

The corporate authorities of each municipality may acquire by eminent domain private lands bordering

Effects on Water of Man's Non-Water Activities—Group 4C

upon public or navigable waters, which are useful or desirable for bathing beaches and recreation piers. (Heckerling-Florida)
W69-10248

STATE AID IN FLOOD CONTROL; MUNICIPAL-FEDERAL FLOOD CONTROL PROJECTS.

Ill Ann Stat ch 24, secs 11-115-1, 11-115.1-1 (Smith-Hurd 1962), as amended, (Supp 1969).

Descriptors: *Illinois, *Federal government, *Contracts, *Flood control, Cities, Legislation, Administrative agencies, Regulation, Bridges, Construction, Pollution abatement, Flood protection, Easements, Right-of-way, Damages, Projects, Operation and maintenance, Construction costs, United States, Flood routing, Waste dumps, Landfills.

Whenever the state appropriates money for the construction of works to protect against floods, the authorities of any municipality benefited may contract with the state to take over and maintain the works. Any city may contract with the United States that with reference to any flood control project constructed by the United States it will: (1) provide lands, easements, and rights-of-way without cost, (2) contribute part of the construction costs, (3) hold and save the United States free and harmless from claims of damages resulting from such construction, (4) maintain and operate all works after completion, (5) establish and enforce flood channel limits for protection of any flood channel, (6) prevent dumping waste material or the creation of fills within any flood channel limits, and (7) regulate the construction of bridges or other structures crossing any waterway. (Heckerling-Florida)
W69-10250

LOCATING SOURCE OF WATER SUPPLY OUTSIDE OF MUNICIPALITIES.

Ill Ann Stat ch 24, secs 11-138-1, 11-138-2 (Smith-Hurd 1962).

Descriptors: *Illinois, *Eminent domain, *Water supply, *Cities, Legislation, Damages, State governments, Reservoirs, Navigable waters, Compensation, Operation and maintenance, Construction, Pollution abatement, Pipelines.

Any water company organized under the laws of this state may construct, maintain, and operate, beyond the corporate limits of a municipality, lines of water-pipe across or under any waters of this state, subject to certain specified conditions. Whenever it is necessary for the construction, maintenance, and operation of lines of water-pipe or reservoirs, or for the protection of reservoirs, submerged land, and the source of supply from contamination, pollution, or damage from any cause, to take or damage private property adjacent to these improvements, that property may be taken or damaged, and the compensation therefor may be ascertained and paid in the manner which may be provided by law for the exercise of the right of eminent domain. (Heckerling-Florida)
W69-10251

4B. Groundwater Management

EVALUATION AND CONTROL OF CORROSION AND ENCRUSTATION IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN, Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 08G.
W69-09910

CONJUNCTIVE USE OF GROUND AND SURFACE WATERS, California State Dept. of Water Resources, Los Angeles.
For primary bibliographic entry see Field 06A.
W69-10012

IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS, California Univ., Los Angeles.
For primary bibliographic entry see Field 02F.
W69-10019

ARTESIAN WELLS.

For primary bibliographic entry see Field 06E.
W69-10067

LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA, Bureau of Reclamation, Sacramento, Calif. N. P. Prokopovich, and D. J. Herbert. Amer Water Works Ass, Vol 60, No 8, p 915-920, Aug 1968. 6 p, 11 fig.

Descriptors: *Subsidence, *Overdraft, *California, *Canals, Drawdown, Water levels, Irrigation water, Damages, Flooding, Submergence.
Identifiers: Delta-Mendota Canal (Calif).

Land subsidence caused by groundwater overdraft is changing the gradient of the Delta-Mendota Canal, California. Bridges are submerged and the canal lining is 1-6 ft lower than when it was installed in some locations. Replacement of well water by canal water for irrigation has ended the overdraft, but continued lag subsidence may be expected to amount to as much as 2 ft in the next 25 yrs. (Knapp-USGS)
W69-10135

GROUND WATER CONSERVATION.

Ind Ann Stat secs 27-1301 thru 27-1316 (1960).

Descriptors: *Indiana, *Groundwater, *Water conservation, *Water pollution, Legislation, Legal aspects, Administrative agencies, Bodies of water, Lakes, Groundwater basins, Water loss, Public health, Regulation, Surveys, Federal government, Permits, Public utilities, Potable water, Streams, Aquifers, Water supply, Beneficial use, Injection, Subsurface waters, Withdrawal, Groundwater.
Identifiers: *Restricted use.

The term 'ground water' is defined to mean all water filling the natural openings under the earth's surface. The term 'waste' is defined to include ground water loss, pollution, or use which is less than the fullest beneficial use. It is the policy of the state to conserve and protect the ground water resources and to provide regulations for its most beneficial use. The department of conservation may designate certain areas of the state where the withdrawal of ground waters exceeds or threatens to exceed its natural replenishment as restricted use areas. When an area is so designated, any entity other than a public utility must obtain a permit to withdraw groundwater in excess of 100,000 gallons per day more than it was using when the area was restricted. Specific methods for enforcing the permit requirement are provided. Entities committing waste of ground water in restricted use areas may be required to return such water to the ground. A permit must be obtained to introduce potable ground water into any underground formations which contain non-potable water. (Keith-Florida)
W69-10298

4C. Effects on Water of Man's Non-Water Activities

DRAINAGE OF ROADBED.

For primary bibliographic entry see Field 06E.
W69-09945

RESERVOIR LOCATION FOR URBAN RECREATION, Purdue Univ., West Lafayette, Ind. W. L. Miller, and R. L. Kilmer. Proc, Fourth Amer Water Resources Conf, N Y, p 669-678, Nov 1968. 10 p, 1 fig, 3 tab, 9 ref.

Descriptors: *Reservoir sites, *Locating, *Recreation, Urbanization linear programming, Optimization, Size, Water resources development, Resources allocation, Population, Cost analysis, Indiana, Regional analysis.

The effect population has upon the optimum size, number and location of water reservoirs was examined. These reservoirs were used primarily for recreational facilities. Two water reservoir systems were compared: (1) the optimum minimum cost reservoir system which provided adequate facilities to satisfy the fixed quantity of recreation demanded, and (2) the restricted minimum cost reservoir system which also adequately provided for the fixed demand, but included reservoirs already constructed in the system at their actual size and in their actual location. A linear programming model was developed and used to minimize the total system cost while still providing adequate facilities for the fixed quantity demanded in the region. The Indiana reservoir system with eleven already constructed reservoirs was taken as an example. The application of the model showed that the total system cost increased by over five million dollars when the optimum solution was modified by forcing eleven reservoirs into the solution. The optimum system showed no obvious increase in the number of reservoirs located close to the urban areas. However, reservoirs near urban areas were larger indicating more urban use of nearby reservoirs in the optimum system. (Thiuri-Cornell)
W69-10022

UNITED STATES V 930.65 ACRES OF LAND IN JEFFERSON COUNTY (VALUATION OF LAND WITHOUT WATER SUPPLY).

For primary bibliographic entry see Field 06E.
W69-10058

SELECTED URBAN STORM WATER RUNOFF ABSTRACTS.

Franklin Inst. Research Labs., Philadelphia, Pa. Science Information Services.

Fed Water Pollut Contr Admin Res Ser WP-20-21, June 1969. 109 p, 573 ref, 3 index. FWPCA Contract No 14-12-467. Published in coop with WR-SIC. Available from Clearinghouse as PB 185-314, at \$3.00 in paper copy and 65 cents in microfiche.

Descriptors: *Abstracts, *Bibliographies, *Storm runoff, *Urbanization, Instrumentation, Flood control, Sewers, Hydraulics, Water quality, Water law, Legislation, Water pollution treatment, Rainfall-runoff relationship, Storm drains, Water pollution sources, Water pollution control.
Identifiers: *Urban hydrology.

Selected urban storm water runoff abstracts is a compilation of abstracts summarizing articles from a variety of technical publications, covering the subjects of urban runoff, storm water discharge, storm sewers, and combined sewers, together constituting 'the problem of urban drainage'. The present compilation represents as complete a bibliographic record as possible of storm water articles, up to 1968. The 187 abstracts from the 1966 edition were indexed, but not otherwise edited or reevaluated. For convenience, the abstracts are classed in 11 sub-topic categories, and arranged by abstract number within each category. Since most of the papers fit into more than one category, the cumulative subject index at the end of the volume provides the necessary access to individual concepts. Each item includes a bibliographic citation, an abstract, and a set of indexing descriptors. Copies of the articles abstracted in most cases can be obtained from research libraries covering water pollution or public health engineering literature. Some are generally available and may be inspected at the offices of the Storm and Combined Sewer Pollution Control Branch, Div of Applied Science and Technology, Federal Water Pollution Control Administration (FWPCA), Department of the Interior, Washington, D.C., 20242. None of the articles are available for distribution by FWPCA. (Knapp-USGS)
W69-10085

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4C—Effects on Water of Man's Non-Water Activities

FLOODS OF JULY 2, 1968, IN JACKSON, MISSISSIPPI,
Geological Survey, Jackson, Miss.
For primary bibliographic entry see Field 02E.
W69-10101

BRADSHAW V STATE HIGHWAY COMM'R (REQUIREMENT OF LANDOWNERS TO MITIGATE CONDEMNATION DAMAGES).

168 SW2d 129-131 (1969).

Descriptors: *Virginia, *Condemnation value, *Eminent domain, *Road construction, Artificial watercourses, Damages, Market value, Judicial decisions, Access routes, Land tenure, Appeals, Property values, Legal aspects, Condemnation. Identifiers: Mitigation of damages.

The state highway commissioner condemned, among other things, a pond on landowners' property for highway construction purposes. Only a portion of the man-made pond had to be taken. The issue was whether evidence concerning the cost of restoring the pond to its original size was admissible. The landowners objected to its admissibility on the ground that they could not be required to enter into a doubtful and speculative enterprise to mitigate damages. The Supreme Court of Appeals of Virginia held this evidence admissible as an aid to the commissioners in fixing the market value of the property before and after taking. The court distinguished a case relied upon by the landowners when the owner of oyster beds was not required to make a highly speculative replant of oysters in order to minimize damages in a condemnation proceeding. (Harris-Fla)
W69-10237

STREAM CAVING AND ROAD CONSTRUCTION.

Ind Ann Stat secs 36-222 thru 36-224 (1949).

Descriptors: *Indiana, *Bank erosion, *Road construction, *Boundaries (Property), Legislation, Legal aspects, Roads, Damages, Watercourses (Legal), Banks, Construction, Land tenure, Land use, Compensation, Assessments. Identifiers: *Fences, *Stream caving.

When any public highway which passes along the bank of any watercourse becomes unsafe because the bank has washed away or fallen in, the road supervisor shall give the owner of the land over which the highway passes notice to move his fence back from the bank of the watercourse so that a new road may be constructed. If the owner fails to remove his fence, the supervisor may have it done. If any building stands so near the watercourse that space is not left for the new road, the supervisor may open the road on the side of the building away from the watercourse. If the owner of the affected property files a claim for damages within a specified time, construction cannot begin until he receives compensation. The method by which damages are to be assessed is set out. (Keith-Florida)
W69-10299

4D. Watershed Protection

SEDIMENTATION IN BROWNELL CREEK SUBWATERSHED NO. 1, NEBRASKA,
Geological Survey, Washington, D.C.
James C. Mundorff.
Geol Surv Water-Supply Pap 1798-C, p C1-C49, 1966. 49 p, 24 fig, 1 plate, 13 tab, 4 ref.

Descriptors: *Sedimentation, *Nebraska, *Reservoir silting, Sediment control, Silting, Desilting, Reservoirs, Sediment yield, Sediment load, Sediment transport, Sits, Sands, Streamflow, Precipitation (Atmospheric), Runoff. Identifiers: *Sediment trap efficiency.

A sedimentation investigation in Brownell Creek subwatershed, Nebraska, was made as part of a nationwide investigation of the trap efficiency of detention reservoirs. The subwatershed is in southeastern Nebraska, has a drainage area of 495 acres, receives an average of 28.75 inches of precipitation annually, has a total relief of about 95 ft, and has a surface mantle composed mainly of loess and glacial till. Average annual runoff was 3.3 inches during 1955-59. Precipitation ranged from significantly below normal in 1955 and 1956 to appreciably above normal in 1957-59. Most of the sediment is silt and clay; generally, less than 10% of the suspended sediment is sand. Of the total sediment, all the sand and much of the silt and clay are trapped. Trap efficiency was between 90 and 95% during 1955-59. During 1955-59, total sediment discharge was about 400 tons, of which 135 tons was discharged during the period June 24-26, 1955. About 77% of the sediment was discharged during 7 outflow periods, each of which was less than 5 days in duration. (Knapp-USGS)
W69-09946

LEACHABILITY OF A WETTING-AGENT TREATMENT FOR WATER-RESISTANT SOILS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 02G.
W69-09989

SOIL WETTABILITY: A NEGLECTED FACTOR IN WATERSHED MANAGEMENT,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 02G.
W69-09991

SEDIMENT--ITS CONSEQUENCES AND CONTROL,
Agricultural Research Service, Washington, D.C.; and Forest Service (USDA), Washington, D.C. For primary bibliographic entry see Field 02J.
W69-10003

PUBLIC WATERSHED ASSOCIATIONS.

Md Ann Code Art 25, Secs 169-218, 200A (1957), as amended, (Supp 1968).

Descriptors: *Maryland, *Watershed management, *Water management (Applied), *Water conveyance, Obstruction to flow, Water utilization, Water control, Flood control, Ditches, Drainage systems, Water conservation, Water rights, Costs, Planning, State governments, Local governments, Legal aspects, Legislation, Assessments, Cost-benefit analysis, Benefits, Maintenance, Operation+ maintenance, Damages, Construction, Construction costs.

The boards of county commissioners, or county council, may establish public watershed associations.

The purposes of the associations will be watershed protection, flood control, conservation, and effective water utilization. The powers and responsibilities of the associations and procedure for their establishment are set forth. Provision is also made for creating a board of watershed viewers to examine proposed improvement plans. The boards of directors of the watershed associations carry out the approved improvement construction plans and manage the improvement works upon completion. The watershed associations may acquire water rights, provided the rights of others to water use is not impaired. The statute sets forth criteria governing: construction of ditches, drains, and other improvements across the land of others; costs of bridge construction over improvements; and dissolution of the watershed associations. (Kelly-Fla)
W69-10028

PUBLIC WATERSHED ASSOCIATIONS.
Md Ann Code Art 25, secs 169-189 (1957).

Descriptors: *Maryland, *Watershed management, *Water management (Applied), *Water conveyance, Obstruction to flow, Water control, Flood control, Ditches, Drainage systems, Water conservation, Costs, Planning, Soil conservation, State governments, Local governments, Legal aspects, Legislation, Administrative agencies, Water utilization.

The boards of county commissioners in the county council of the several counties of Maryland have the power to establish public watershed associations in their respective counties for the purpose of constructing and managing improvements for watershed protection, flood prevention, recreation, soil conservation, drainage, and for conservation, utilization, and disposal of water. The associations, once established, are authorized to cooperate with local, county, state and federal agencies in their operations. Landowners may petition a board of county commissioners for establishment of a watershed association. The association shall be governed by a board of directors which is responsible for developing plans for improvements and filing these with the county commissioners. The county commissioners shall appoint a board of watershed viewers to examine the area to be improved and to engage engineers for surveys. (Kelly-Fla)
W69-10029

PUBLIC WATERSHED ASSOCIATIONS.
Md Ann Code Art 25, secs 190-209 (1957).

Descriptors: *Maryland, *Watershed management, *Water management (Applied), *Water conveyance, Water utilization, Water control, Drainage systems, Water conservation, Water rights, Costs, Planning, State governments, Local governments, Legal aspects, Legislation, Assessments, Cost-benefit analysis, Benefits, Maintenance, Operation+ maintenance, Damages, Construction, Construction costs.

The board of watershed viewers may adopt any existing works as a part of proposed watershed improvements. Costs of improvements can be proportionately assessed against owners of benefited land. The statute provides procedures for settling contested damages awards for appropriated property and gives the board of watershed viewers authority to acquire necessary rights-of-way through condemnation. Bonds may be issued to finance construction of improvements. The board of directors for the public watershed association shall carry out the plan of watershed improvement, may employ laborers, and may purchase materials for construction. The board of directors is responsible for maintaining the improvements made and may levy taxes against benefited property for operation costs. (Kelly-Fla)
W69-10030

PUBLIC WATERSHED ASSOCIATIONS.
Md Ann Code Art 25, secs 210-218 (1957).

Descriptors: *Maryland, *Watershed management, *Water management (Applied), *Water conveyance, Water utilization, Water control, Flood control, Ditches, Drainage systems, Water rights, Costs, Planning, State governments, Local governments, Legal aspects, Legislation, Bridges, Highways, Construction costs.

The board of directors of any public watershed association may acquire water rights under existing law and may carry out improvement works for storage, utilization and distribution of water. The board is authorized to charge for water use, and to use any proceeds as payment for water rights and for management of the improvement works. The board is prohibited from interfering with the legal water rights of others. Any person taxed for a main ditch or drain which does not pass through or under his land may open a ditch through intervening land to such main ditch with consent of the owner of the intervening land. Obstruction of any ditch, drain, or other improvement made pursuant to this subti-

tle is a misdemeanor. Where a ditch or other improvement intersects a highway at the location of a natural watercourse, the county highway authority must pay for needed bridges. At other intersections the watershed association must bear bridge construction expenses. The board may develop supplemental plans for watershed works. A majority of landowners in a public watershed association may petition for dissolution to the county commission. (Kelly-Fla)
W69-10031

FLOOD CONTROL.
For primary bibliographic entry see Field 06E.
W69-10072

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

CHEMISTRY OF N AND MN IN COX HOLLOW LAKE,

Florida Univ., Gainesville.
Patrick L. Brezonik, Joseph J. Delfino, and G. Fred Lee.
ASCE Proc, J Sanit Eng Div, Vol 95, No SA 5, p 929-940, Oct 1969. 12 p, 7 fig, 2 tab, 14 ref, 1 append.

Descriptors: *Water chemistry, *Lakes, *Aeration, Stratification, Mixing, Oxidation, Nitrification, Manganese, Sorption, Reservoirs, Water temperature, Water pollution treatment.
Identifiers: *Destratification.

Concentrations and forms of nitrogen and manganese species were determined in Cox Hollow Lake, Wisconsin, after the lake was destratified by artificial aeration. Destratification of this impoundment was accomplished within one month of aeration and dissolved oxygen appeared throughout the water column at the same time. Nitrogen (mainly Kjeldahl N) decreased in the lake during destratification, apparently as a result of sedimentation. Nitrate and nitrite appeared in the water column soon after the initial appearance of oxygen in the bottom water but rates of nitrification were estimated to be low, 3 mg per liter to 40 mg per liter. Inorganic nitrogen remained low following destratification. Destratification was also effective in removing manganese from the hypolimnion; bottom concentrations decreased from about 2 mg Mn per liter to about 0.3 mg Mn per liter after one month of aeration. About 50% of the total Mn was particulate. After reoxygenation some of the particulate Mn was found to be oxidized Mn, but most particulate Mn was Mn (II), presumably sorbed onto inorganic or organic particles. (Knapp-USGS)
W69-09881

RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT,
New York State Dept. of Health, Albany. Div. of Laboratories and Research; State Univ. of New York, Albany. Dept. of Biological Sciences; and State Univ. Coll., Fredonia, N.Y.
For primary bibliographic entry see Field 05C.
W69-10080

WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA.
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 03F.
W69-10294

5B. Sources of Pollution

STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES,

Virginia Polytechnic Inst., Blacksburg, Va.
Stephen W. Custer, and Richard G. Krutchkoff.
ASCE, J Sanit Eng Div, Vol 95, No SA 5, p 865-886, Oct 1969. 22 p, 8 fig, 11 ref, 2 append.

Descriptors: *Oxygen demand, *Estuaries, *Statistical models, Biodegradation, Biochemical oxygen demand, Dissolved oxygen, Water pollution effects, Water pollution control, Stochastic processes, Path of pollutants, Dispersion, Mixing, Probability.
Identifiers: *Potomac Estuary, Stochastic models.

The BOD and DO of estuaries was studied by using a statistical model of the biodegradation of pollutants. Using the assumption that the degrading process in nature is discrete rather than continuous, a stochastic model is constructed for the process. Unlike the results previously obtained for streams the mean effects did not coincide with previously obtained deterministic results. The mean effect and the fluctuations about this effect were compared with data from the Potomac estuary. The comparison is remarkably good, and strongly indicates the validity of the stochastic model. (Knapp-USGS)
W69-09879

MONTE CARLO SIMULATION OF WASTE DISCHARGE,

Wisconsin Univ., Madison.
Paul M. Berthouex, and Linfield C. Brown.
ASCE, J Sanit Eng Div, Vol 95, No SA 5, p 887-906, Oct 1969. 20 p, 4 tab, 12 fig, 16 ref, 2 append.

Descriptors: *Waste disposal, *Industrial wastes, *Water pollution control, *Simulation analysis, *Statistical models, Monte Carlo method, Computer models, Sewage treatment, Systems analysis, Optimization.
Identifiers: Waste discharge models.

The concepts of Monte Carlo simulation, in conjunction with relevant concepts from probability and statistics, are presented by illustrating their application to an industrial waste peak load smoothing problem. A tanning operation consisting of 8 batch processes and 2 continuous flow processes, is simulated. The formulation of all input data and assumptions is described in detail and the logic involved in programming the simulation is explained. The simulator was used to examine the possibility of smoothing peak loads, in terms of both flow and organic load, by altering the schedule of waste liquors from the various batch tanning processes. Several typical and important questions can be answered using the concepts. The basic concepts are presented in simple and general terms to facilitate and encourage the use of simulation in other industrial waste problem situations. (Knapp-USGS)
W69-09880

DISTRIBUTION OF PESTICIDES IN SURFACE WATERS,

Virginia Polytechnic Inst., Blacksburg, Va.
Paul H. King, H. H. Yeh, Pierre S. Warren, and Clifford W. Randall.
J Amer Water Works Ass, Vol 61, No 9, p 483-486, Sept 1969. 4 p, 7 fig, 2 tab, 7 ref.

Descriptors: *Pesticide kinetics, *Pesticide removal, *Adsorption, Soils, Coals, Distribution patterns, Activated carbon, Clays, Algae, Water purification, Water quality, Water chemistry.
Identifiers: Pesticide sorption.

Several papers on pesticide distribution in water, pesticide sorption in soil, and pesticide removal technology are reviewed and summarized, and ex-

perimental data are presented on pesticide sorption by soils, algae, and activated carbon. The pesticides studied are lindane and parathion. Experimental results are shown by sorption isotherms. In general, high-clay soils adsorbed about twice as much pesticide as sandy soils. Algae sorbed about 10 times as much as soils. Coal adsorbed about 2 1/2 times as much as soil, and activated carbon adsorbed about 4 orders of magnitude more than soil. (Knapp-USGS)
W69-09884

INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT,

Texas Univ., Austin.
Chia-Shun Shih, and Ernest F. Gloyne.
ASCE Proc, J Hydraul Div, Vol 95, No HY 4, Pap 6699 p 1347-1367, Jul 1969. 21 p, 15 fig, 7 tab, 10 ref, 2 append.

Descriptors: *Path of pollutants, *Radioactive wastes, *Solutes, *Mathematical models, *Tracers, Strontium radioisotopes, Ion exchange, Adsorption, Dispersion, Sediment transport, Computer programs.
Identifiers: Solute transport.

A mathematical model which describes the transport of radionuclides injected instantaneously in a stream is developed. Instantaneous release of dye and continuous release of Sr-85 respectively, are used to measure the dispersion and mass transfer coefficients. Aquaria and model river experiments are undertaken to determine various parameters which define the mechanism of sorption and desorption of radionuclides by sediments. Instantaneous injection of Sr-85 into the model river provides data for establishing the relationship between the analytical solution and a proposed mathematical model. FORTRAN programs are designed for the analyses of gamma spectra, dispersion coefficients and transport equations. The mass transfer coefficient is found to increase with increased velocity. High uptake of Sr-85 by sediments may be provided by increased temperature and the presence of an organic pollutant. An exponential relationship is established between the Sherwood's number and the Reynold's number for the model river. (Knapp-USGS)
W69-09891

MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS,

Geological Survey, Washington, D.C.
James F. Wilson, Jr., Ernest D. Cobb, and Nobuhiro Yotsukura.
Geol Surv Circ 529-B, 1969. 14 p, 12 fig, 2 tab, 3 ref.

Descriptors: *Path of pollutants, *Estuaries, *Tracers, *Dye releases, *Aerial photography, Solutes, Dispersion, Diffusion, Streamflow, Tides, Currents (Water).
Identifiers: *Potomac River.

The movement of a solute, as represented by a soluble fluorescent dye, was observed in the Potomac River estuary at Washington, D.C. The average net rate of downstream movement of the solute centroid was less than 0.6 mi/day. The movement of a solute is highly dependent on the nontidal inflow to the estuary. During the study, the average inflow was 900 cfs, a very low value, equaled or exceeded 98% of the time. Using a storage equation, the average movement of a solute was estimated for nontidal inflow of 3,100 and 6,500 cfs; these inflows are equaled or exceeded 75 and 50% of the time, respectively. Tidal action was fairly efficient in dispersing the solute longitudinally. The solute, which was dumped 1,000 ft upstream from the 14th Street Bridge, was observed as far upstream as Roosevelt Island. A transient longitudinal dispersion coefficient at the end of 150 hr was determined to be 210 sq ft per second. On the other hand, the lateral diffusion was a slow process and the lateral distribution of the solute was far from

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

uniform at the end of 6 1/2 days after the release. (Knapp-USGS)
W69-0994

WATER QUALITY OF MOUNTAIN WATERSHEDS,

Colorado State Univ., Fort Collins.
Samuel H. Kunkle, and James R. Meiman.
Colo State Univ Hydrol Pap No 21, June 1967. 53 p, 33 fig, 9 tab, 19 ref, append.

Descriptors: *Water quality, *Streamflow, *Aquatic bacteria, *Solutes, *Turbidity, Mountains, Irrigation, Grazing, Coliforms, Sampling, Surveys, Color, Data collections, Statistical methods.

Identifiers: Mountain streams.

Water quality was investigated from April 1964 to September 1965 on mountain watersheds 7,600-9,790 ft high in the Colorado Front Range to assess water quality characteristics at varying natural flow regimes under conditions of limited land use. A total of 604 samples were taken. The parameters measured were: flow; water temperature; pH; turbidity; suspended sediment; dissolved solids; and total, coliform, fecal streptococcus (FS), and fecal coliform (FC) bacteria. Bacteria concentrations were closely related to the physical parameters of the stream and were especially dependent on the flushing effect of high runoffs. The seasonal trends of all bacteria groups were similar: (1) low counts prevailed while the water was 0 deg C; (2) high counts appeared during rising and peak flows; (3) a short post-flush lull in counts took place as runoff receded in early July; (4) high counts were found again in July-August; and (5) counts declined in September. The FC, FS, and coliforms all clearly defined grazing-irrigation impact; the FC showed the highest sensitivity to such pollution. The coliforms rated slightly less, while the FS were the least sensitive. Minimum pH values occurred near the peak flow, with a total range of from 6.3 to 8.7. There was a 0.1 to 0.2 pH unit decrease per 1000 ft of elevation. Turbidity and suspended sediment were positively related to flow and to each other. No relations between dissolved solids and other physical or bacterial parameters were found. (Knapp-USGS)
W69-0994

OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS,

Manhattan Coll., Bronx, N.Y. Dept. of Civil Engineering.

Robert V. Thomann.

Proc, Fourth Amer Water Resources Conf, N.Y., p 115-122, Nov 1968. 8 p, 4 fig, 3 ref.

Descriptors: *Dynamic programming, *Water quality control, *Waste treatment, *Stream improvement, *Estuaries, *Variability, Dissolved oxygen, Mathematical models, Delaware River, Fluctuation, Linear programming, Optimization. Identifiers: Green River (Wash).

The use of dynamic water pollution control models instead of steady or quasi steady state models was discussed. Various steady state optimization schemes using linear or dynamic programming techniques could be employed to determine the 'best' combination of waste treatment that met a steady state dissolved oxygen (DO) objective. However, the analysis failed to recognize the dynamic nature of the environment. A study of response time for the Green River in Washington and the Delaware Estuary revealed that it took hours for the former and weeks for the latter to reach a specified control level, small streams responding more rapidly than large estuaries. Waste inputs were found to vary also. Analysis of the characteristics of waste load fluctuations for the City of Philadelphia indicated a degree of random behavior with tendencies for seasonal and weekly periodicities. A control model that incorporated the dynamic aspects of optimum water quality control systems was then developed. (Thiuri-Cornell)

W69-10024

SEWAGE DISPOSAL SYSTEMS ON ISLANDS.

For primary bibliographic entry see Field 06E.
W69-10034

WATER POLLUTION AND DISPOSAL OF WASTES.

NH Rev Stat Ann secs 149:1 thru 149:19 (1964), as amended, (Supp 1967).

Descriptors: *New Hampshire, *Regulation, *Water pollution, *Sewage, Legislation, Waste, Surface water, Ground water, Biochemical oxygen demand, Impaired water quality, Public health, Microenvironment, Non-consumptive use, Industrial wastes, Bacteria, Coliforms, Standards, Classification, Administrative agencies.

Identifiers: Penalties (Criminal).

The New Hampshire Water Pollution Commission is established. Its duties include the authority to issue orders and regulations for the protection of public health to provide procedures for enforcement, and to establish penalties to be exacted for violations thereof. Standards and procedures for classification of state surface waters are set forth. Authorization for the state to guarantee, unconditionally, the payment of all or any portion of the principle and interest on bonds and notes issued by any municipal government for the construction of sewage systems or other pollution control facilities is provided. Geographical areas are assigned water classifications. Such classifications are to be enforced by appropriate court action. Procedures for procuring general variance authorization are provided, with special provisions for seasonal and emergency variances. Appropriate penalties for violation of these provisions are set forth. (Moulder-Fla)
W69-10035

WATER POLLUTION AND DISPOSAL OF WASTES.

NH Rev Stat Ann secs 149:1 thru 149:3 (1964), as amended (Supp 1967).

Descriptors: *New Hampshire, *Sanitary engineering, *Public health, *Environmental engineering, Legislation, Regulation, Water pollution, Waste disposal, Surface waters, Wastes, Biochemical oxygen demand, Bacteria, Coliforms, Water pollution sources, Sewage treatment, Sewage bacteria, Dissolved oxygen, Oxygen requirements, Standards, Classification.

The New Hampshire Water Pollution Commission's primary duties are to police state water pollution and waste disposal. Surface waters are divided into the following classifications. Class A waters are of the highest quality and shall contain not more than fifty coliform bacteria per one hundred milliliters; no discharge of sewage waste into these waters is permissible. Class B waters are divided into two subclasses. B1 shall have no objectionable physical characteristics, shall be near saturation for dissolved oxygen, and shall contain not more than two hundred forty coliform bacteria per one hundred milliliters. These waters are acceptable for bathing and recreation. B2 waters contain not more than one thousand coliform bacteria per one hundred milliliters and are acceptable for boating, fishing, and industry. Class C waters shall contain not less than five parts per million of dissolved oxygen with a hydrogen ion concentration within pH 5.0 to 8.5 and are acceptable for boating, fishing, and industrial use. Class D waters shall contain dissolved oxygen at all times. (Moulder-Fla)
W69-10036

WATER POLLUTION AND DISPOSAL OF WASTES.

NH Rev Stat Ann secs 149:4 thru 149:7 (1964), as amended (Supp 1967).

Descriptors: *New Hampshire, *Regulation, *Sanitary engineering, *Water pollution control, Legislation, Public health, Water pollution, Waste disposal, Surface waters, Industrial wastes, Stream pollution, Classification, Evaluation, Financing, Interstate.

The New Hampshire Water Pollution Commission shall supervise the administration and enforcement provisions concerning water pollution and waste disposal, study and investigate all problems connected with the pollution of surface waters, conduct scientific experiments concerning treatment of industrial wastes to control pollution of state surface waters, investigate and approve the applications of municipalities requesting available state or federal aid in the interest of pollution control, and confer with responsible authorities of other states concerning methods, means, and measures to be employed in controlling pollution in inter-state streams and other waters. The commission must follow certain procedures pertaining to notice, public hearing, and review of its classification of all streams, lakes, ponds, and tidal waters. After classification of any surface water, the Commission may reinvestigate the conditions of pollution and may make recommendations to the legislature for reclassification. (Moulder-Fla)
W69-10037

WATER POLLUTION AND DISPOSAL OF WASTES.

NH Rev Stat Ann secs 149:8 thru 149:19 (1964), as amended, (Supp 1967).

Descriptors: *New Hampshire, *Regulation, *Classification, *Pollution abatement, Legislation, Waste disposal, Evaluation, Pollution, Legal aspects, Water resources development, Public health, Standards, Water pollution control, Local governments, Industrial wastes.

Identifiers: Penalties, Enforcement.

The New Hampshire Water Pollution Commission shall enforce the adopted water classification by appropriate actions in the state courts. It is unlawful for any person to dispose of wastes in such a manner as to lower the classification of surface water below the minimum requirements of the adopted classification. If the quality of classification water is lowered by pollution, the person responsible shall be required to abate such pollution within a fixed time. If the pollution is of municipal or industrial origin, the time requirement is not less than two nor more than five years, which time limit may be extended by the Commission. Within six months after adoption of a given classification by the legislature, any person chargeable with the responsibility of abating pollution as a result of such classification may apply to the superior court in and for the county in which such pollution is occurring for a variance in such classification as applied to his specific case. The court, after a hearing, may enter a decree authorizing a variance from the classification in the specific case before it if such variance will not be contrary to the public interest. (Moulder-Fla)
W69-10038

RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT, New York State Dept. of Health, Albany. Div. of Laboratories and Research; State Univ. of New York, Albany. Dept. of Biological Sciences; and State Univ. Coll., Fredonia, N.Y.
For primary bibliographic entry see Field 05C.
W69-10080

THE DECOMPOSITION OF PETROLEUM PRODUCTS IN OUR NATURAL WATERS,

Mississippi State Univ., State College. Dept. of Microbiology.
Lewis R. Brown, and Robert G. Tischer.
Miss State Univ Water Resources Research Inst Completion Rep, July 1969. 31 p, 8 fig, 3 tab, 5 ref. OWRR Proj no A-027-Miss.

Effects of Pollution—Group 5C

Descriptors: *Biodegradation, *Oil wastes, *Surface waters, Water pollution control, Water chemistry, Microorganisms, Aquatic microorganisms, Bacteria, Toxicity, Fishkill, Phytotoxicity, Analytical techniques, Nutrients.
Identifiers: Oil spills, Oil pollution.

An investigation was made to study the decomposition of crude and refined petroleum in natural waters by investigating the physical, chemical, and microbiological changes that occur in fresh and brackish water environments during the decomposition of crude and refined petroleum products and investigating the effects of the microbial by-products on fish. The microflora caused marked physical changes in the oil under both aerobic and anaerobic conditions, using both fresh water and artificial seawater. The disappearance of oil was more rapid under aerobic conditions. A thin layer chromatographic technique was developed and employed to demonstrate chemical changes that occurred in the oil during microbial decomposition under all of the conditions employed. The addition of a nitrogen source and supplemental inorganic phosphate enhanced microbial activity. Waters in which the microbial degradation of oils had taken place were toxic for fish even after separation and removal of bacteria and oil. These data suggest that water-soluble products formed during the microbial decomposition of the petroleum products are harmful to fish. (Knapp-USGS)
W69-10082

OCCURRENCE OF SULFATE AND NITRATE IN RAINFALL,
Geological Survey, Washington, D.C.
Arlo W. Gambell, and Donald W. Fisher.
Journal of Geophysical Research, Vol 69, No 20, p 4203-4210, Oct 1964. 7 fig, 1 tab, 13 ref.

Descriptors: *Rainfall, *Sulfates, *Nitrates, Virginia, Atmosphere, Thunderstorms, Lightning, Sampling, Precipitation (Atmospheric), Snow, Chlorides, Calcium, Sodium, Potassium, Ammonia, Aerosols, Brines, Organic matter, Industrial plants, Agricultural chemicals, Evaporation, Winds, Water pollution sources.
Identifiers: Prince William National Forest Park (Va), Gaseous constituents, Soil dust, Sea-salt, Fossil fuels, Photochemical processes.

Authors studied the mineral composition of individual rainfalls at Prince William National Forest Park, Virginia. Data are presented showing variations in rainfall composition during the course of six storms. Sulfate, nitrate, chloride, calcium, sodium, and potassium ions were determined for all samples. Ammonium ion was determined only for thunderstorm samples. Easiest to account for are those constituents derived almost solely from particulate aerosols. These include calcium, sodium, and chlorine ions. With few exceptions, soil dust and sea-salt aerosols will adequately explain the presence of these. The data support the theory that much of the sulfate ion in rainfall is formed from the oxidation of sulfur dioxide in cloud droplets. It is suggested that atmospheric nitrogen peroxide, acting as a catalyst, is important in this reaction. The data indicate that sulfate ion, nitrate ion, and ammonium ion in rainfall are derived primarily from gaseous constituents of the atmosphere. Origin of nitrate ion in thunderstorm rainfall is discussed and evidence is given to show that role of lightning is almost certainly unimportant. High nitrate ion concentrations reported for thunderstorm rainfall could be explained by nitrogen oxides present in the air mass before a thunderstorm occurs. (Jones-Wis)
W69-10153

ALGAL RESPIRATION IN A EUTROPHIC ENVIRONMENT,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
Archie J. McDonnell, and R. Rupert Kountz.
Journal of Water Pollution Control Federation, Vol 38, No 5, p 841-847, May 1966. 5 fig, 3 tab, 9 ref.

Descriptors: *Algae, *Respiration, *Eutrophication, *Dissolved oxygen, Pennsylvania, Biochemical oxygen demand, Temperature, Flow, Sampling, Waste water disposal, Diurnal, Effluents, Nitrogen, Phosphates, Alkalinity, Fish, Streams, Water pollution effects, Water pollution sources, Nutrients.
Identifiers: Spring Creek (Pa), State College (Pa), Flora.

Present-day community development, especially in small watersheds, such as Spring Creek, Pennsylvania, has compounded problems of stream pollution criteria. In many stream situations, depletion of dissolved oxygen resources is a result not only of biochemical oxygen demand (BOD) but also of the effect of community respiration. Exactly how much effect each of these factors has on the dissolved oxygen level of the stream is difficult to evaluate. With statistical methods of regression and variance analysis, it was possible to define the BOD parameter as one of secondary engineering significance and to evaluate quantitatively the nocturnal oxygen demands of a heterogeneous stream flora. Community plant respiration varies directly with stream temperature and inversely with stream flow. Chemical analysis of contributing sources indicated nutrient concentrations sufficient to induce and maintain a eutrophic environment. On this basis, where population-to-receiving water resource ratio is high, analysis for significance of parameters other than BOD should be made and the findings manifested in the treatment process. The solution appears to lie in the removal of nitrogen and phosphorus from the wastewater treatment plant effluent before it enters the creek waters, which practically implies total exclusion. (Jones-Wis)
W69-10159

INDUSTRIAL POLLUTION OF INTERNATIONAL BOUNDARY WATERS ALONG THE NIAGARA FRONTIER,
H. H. Black and E. Devendorf.
Sewage and Indust. Wastes, Vol 26, p 1259-1285, 1954.

Descriptors: *Industrial wastes, Water pollution sources, Sewage.
Identifiers: *Flow rates.

Sources and types of pollution from the areas highly concentrated industries are described in relation to the use of the boundary waters. Despite tremendous flows in the rivers, there is a marked tendency in the upper Niagara River for sewage and industrial wastes to follow and remain along the shore. (Livengood-North Carolina)
W69-10291

WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA.
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 03F.
W69-10294

5C. Effects of Pollution

ARTIFICIAL Destratification IN RESERVOIRS OF THE CALIFORNIA STATE WATER PROJECT,
California State Dept. of Water Resources, Sacramento.

John R. Teerink, and Cecil Martin.
J Amer Water Works Ass, Vol 61, No 9, p 436-440, Sept 1969. 5 p, 2 fig, 2 tab, 16 ref.

Descriptors: *Stratification, *Reservoir operation, *Mixing, *Reaeration, *California, Thermal stratification, Economics, Cost-benefit analysis, Water circulation, Productivity, Water quality, Water chemistry.
Identifiers: Reservoir destratification.

Destratification and aeration in California reservoirs are accomplished by air injection and multiple-level outlet structures. Mixing returns nutrients to the photosynthetic zone for use by organisms, and oxidizes iron and manganese. The effects may be beneficial or detrimental to intended water uses. Evaporation is usually reduced because surface water temperatures are lowered. Dissolved oxygen is increased. Because artificial destratification can produce both benefits and detriments, a study should be made of priority of uses and the effects of mixing, and cost-benefit analyses should be made, placing a value on the various quality changes related to mixing. (Knapp-USGS)
W69-09883

WATER QUALITY OF MOUNTAIN WATERSHEDS,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 05B.
W69-09943

EPIDEMIC GARDIASIS AT A SKI RESORT,
G. T. Moore, W. M. Cross, D. McGuire, C. S. Mollohan, and N. N. Gleason.
New Engl J Medicine, Vol 281, No 8, p 402, 407, Aug 21, 1969. 6 p, 3 fig, 2 tab, 35 ref.

Descriptors: *Water pollution effects, *Epidemics, *Protozoa, *Epidemiology, *Skiing, *Colorado, Sewers, Leakage, Diseases, Public health, Sewage, Recreation, Animal parasites, Pathology, Human diseases, Water pollution.
Identifiers: *Aspen (Colo), Giardiasis.

An outbreak of protracted, intermittent diarrhea, often associated with symptoms suggesting malabsorption, occurred in persons who vacationed in Aspen, Colorado, during the 1965-66 ski season. A survey of 1094 skiers showed that the characteristic illness had developed in at least 11.3%. The association of Giardia lamblia with the illness, the absence of other pathogens, and the response to treatment suggest that G. lamblia was the agent responsible for the illness. Environmental studies carried out after the epidemic demonstrated contamination of well water by sewage leaking from defective pipes passing near wells. G. lamblia cysts were found in the sewage from the defective pipes and in stools from 6.9% of the permanent residents of the city living in the area served by the defective sewage lines. The findings are consistent with a hypothesis of water-borne spread of giardiasis. (Knapp-USGS)
W69-10079

RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT,
New York State Dept. of Health, Albany. Div. of Laboratories and Research; State Univ. of New York, Albany. Dept. of Biological Sciences; and State Univ. Coll., Fredonia, N.Y.
N. I. Sax, Paul C. Lemon, Allen H. Benton, and Jack J. Gabay.
Radio Health Data and Rep, Vol 10, No 7, p 289-296, July 1969. 8 p, 3 fig, 6 tab, 26 ref. USPHS Service grant, Nat Center for Radiological Health.

Descriptors: *Monitoring, *Radioisotopes, *Streams, Bioindicators, *New York, Nuclear wastes, Water pollution sources, Path of pollutants, Aquatic life, Algae, Silts, Ecology, Aquatic environment.
Identifiers: Cattaraugus Creek (NY).

A 3-yr study of the aquatic ecosystem around a nuclear fuels reprocessing plant, located in western New York State, was conducted to find and evaluate natural indicators of environmental contamination. The study covered preoperational and early post-operational phases. The ecological vectors selected for study were algae, silt, and fish, all from Cattaraugus Creek and its tributaries. Samples were collected at several points upstream and downstream from the plant effluent and quantita-

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

tively analyzed by gamma-ray spectrometry. All vectors analyzed indicated process of uptake and concentration of ruthenium-rhodium-106, cesium-137, cesium-134, and/or zirconium-niobium-95, and sometimes cobalt-60. In addition, the concept of using natural indicators not native to the streams under study was tested by translocating fresh water clams from Chautauqua Lake, 60 mi southwest of the site, and placing them in the streams around the plant. The clams not only thrived in their new environment but upon analysis showed definite interaction by concentration of the above radioisotopes, with the shells showing approximately twice the radioactivity of the soft parts of the clam. This concept might prove to be a sensitive indicator of environmental contamination. (Knapp-USGS)
W69-10080

THE DECOMPOSITION OF PETROLEUM PRODUCTS IN OUR NATURAL WATERS,
Mississippi State Univ., State College. Dept. of Microbiology.
For primary bibliographic entry see Field 05B.
W69-10082

EFFECTS OF SURFACE MINING ON THE FISH AND WILDLIFE RESOURCES OF THE UNITED STATES,
Bureau of Sport Fisheries and Wildlife, Washington, D.C.
Willard M. Spaulding, Jr., and Ronald D. Ogden.
Bur Sport Fish and Wildlife Resource Publication 68, Aug 28, 1968. 51 p, 3 fig, 31 photo, 10 tab, 18 ref, 3 append.

Descriptors: *Environmental effects, *Strip mines, *Acid mine water, Wildlife habitats, *Sport fishing, Strip mine lakes, Strip mine wastes, Edge effect, Habitats, Toxicity, Water pollution sources, Water pollution effects, Water pollution control, Data collections.
Identifiers: Surface mining effects, Fish and wildlife resources.

Data obtained in a study of the effects of surface mining on fishing resources are compiled. About 2 million acres of fish and wildlife habitat are damaged by mining. This includes 13,000 mi of streams (135,970 acres), 281 lakes (103,630 acres), 168 reservoirs (41,516 acres) and 1,687,288 acres of land; 62% of the damage is east of the Mississippi. Problems are discussed and recommendations are made for their solutions. (Knapp-USGS)
W69-10137

PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE,
Akademija Nauk SSSR, Moscow. Institut Biologii Vnutrennykh Vod.
S. M. Drachev, and V. Ye. Sinel'nikov.
Transl from Vestnik Moskovskogo Univertiteta, SER. Geograf No 4, 1968, p 23-30. Soviet Hydrol Selec Pap No 3, p 284-289, 1968. 6 p, 1 fig, 4 tab, 15 ref.

Descriptors: *Water pollution, *Rivers, *Industrial wastes, *Municipal wastes, *Water pollution effects, Water pollution control, Biodegradation, Oxygen demand, Surfactants, Foaming, Path of pollutants, Water treatment, Waste treatment.
Identifiers: *USSR, *Moskva River.

Chemical and municipal pollution of the Moskva River, USSR cause changes which spread far from the sources of pollution. The Moskva River is a small river, 502 km long. In its upper reaches (285 km) it crosses the northwestern part of Moscow Province. From its head waters to the capital, the river flows over the Klin-Mozhaysk morainic plain, interrupted by the basins of old lakes and hollows. Much of the Moskva River catchment above the capital is included in a sanitary protection zone, covering 7,300 sq km. The work performed in the

sanitary protection zone included the drainage of bogs, forest conservation for controlling soil erosion, and construction of sewage treatment plants in populated areas. The construction of industrial buildings is prohibited in the protection zone. More than 200 populated areas, mainly villages and vacation spots, are located in the second belt of the sanitary protection zone. The sewage is treated at biological stations and filtration fields. The Moskva River in the city and especially below it has been changed in hydrologic regime, banks and bottom, and the mineral and organic composition of water. The number, composition, and leading species of water organisms have changed. By 1980, the release of sewage into the Moskva River after purification will amount to 60 cu m/sec. The water at the intakes of the Rubley and Zapadnaya water works is slightly colored, highly mineralized, very transparent, and has a small content of organic substances. The impurities derived from the city concentrate at the Pererva dam to the southeast of the Moscow city limit. The highest concentrations of industrial pollution indexes were found in this river reach, including chromium, lead, cobalt, molybdenum, and surfactants. (Knapp-USGS)
W69-10139

A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND,
Marine Lab., Aberdeen (Scotland); and Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
For primary bibliographic entry see Field 02L.
W69-10150

THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHORYLATION, AND MACROMOLECULES IN BENTHIC ALGAL MATS,
Indiana Univ., Bloomington. Dept. of Microbiology.
Thomas D. Brock, and M. Louise Brock.
Limnology and Oceanography, Vol 12, No 4, p 600-605, Oct 1967. 1 fig, 2 tab, 13 ref.

Descriptors: *Benthic flora, *Chlorophyll, *Primary productivity, *Measurement, Proteins, Radioactivity, Carbon radioisotopes, Phosphorus radioisotopes, Algae, Biochemistry, Ecology, Sampling, Thermal springs, Effluents, Cyanophyta.
Identifiers: *Photophosphorylation, *Macromolecules, Nucleic acid, Ribonucleic acid synthesis.

This is part of a study of the biochemical ecology of thermal environments. Along the gradients of hot-spring effluents, algae develop on the bottoms of sinter-lined channels. Thickness and consistency of the mat is determined by temperature, flow rate, and type of flow--whether turbulent or laminar. In channels with laminar flow, the algal mats are relatively uniform over several square decimeters. Methods are described for measuring primary productivity, chlorophyll, protein, and nucleic acid in algal cores. The cores are homogenized after incubation with a radioactive isotope allowing representative subsampling. Isotope self-absorption is not a problem, because only a small fraction of the core is actually filtered. The method eliminates sampling variability since chlorophyll is estimated in the same samples used to determine carbon-14 (C-14) uptake. Acid or alkali extraction was used to indicate the biochemical fractions into which the C-14 was incorporated. Total phosphate content of the spring water was determined chemically for calculation of specific radioactivity of phosphate-32 (P-32) ion. Rates of photophosphorylation and ribonucleic acid synthesis were measured using P-32. All work was done with blue-green algae, and method should not be applied to other algae without preliminary testing. (Jones-Wis)
W69-10151

QUANTITATIVE RELATIONS OF THE FEEDING AND GROWTH OF DAPHNIA PULEX OB-TUSA (KURZ) SCOURFIELD,
Department of Water Technology, Prague (Czechoslovakia).
N. M. Krytchko, and V. Sladecek.
Hydrobiologia, Vol 33, No 1, p 47-64, 1969. 9 fig, 4 tab, 51 ref.

Descriptors: *Feeding rates, *Growth rates, *Daphnia, Productivity, Bioindicators, Secondary productivity, Aquatic productivity, Water pollution effects, Yeasts, Crustacea, Algae.
Identifiers: *Daphnia pulex obtusa, Scenedesmus quadridens, Ecological efficiencies, Trophic ecology, Cladocera.

Authors fed individual newborn cladocerans, Daphnia pulex obtusa, three concentrations of yeast (5, 10, 20 milligrams/liter), or algae, Scenedesmus quadridens (5, 10, 15 milligrams/liter) in ten replicated experiments per treatment. Duration of life, growth, and fecundity were recorded for each daphnid. With increasing concentrations of yeast, mean total egg production increased from 101 to 192; with algae, from 154 to 270. Mean body-length of daphnid fed yeast attained 2.4 millimeters; algae fed, 2.9 millimeters. Of total production (body weight+ egg weight), 66-75% was utilized for reproduction in entire period to death, beginning 5-6 days after inception of sexual maturity. Relative average daily daphnid growth (ADG) was greater in early life, decreasing with age; increased with increasing concentrations of food, and was greater with algal food than with yeast. Authors claim that values for ADG (range: 0.23-0.46 for all treatments) are high and indicate that this daphnia is adapted for life in polluted water. For increasing algal concentrations, average daily ratio increased (39.1%, 58.8%, 75.9% daphnid dry weight); efficiency of food-utilization for growth decreased (56.1%, 47.9%, 35.7%). Filtration rate for life span decreased with increasing algal concentration from 842.3 to 400 milliliters/milligram dry daphnid weight. (Eichhorn-Wis)
W69-10152

FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO MOUNTAIN LAKES,
Colorado Univ., Boulder. Dept. of Biology.
For primary bibliographic entry see Field 02H.
W69-10154

EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO,
Scarborough Coll., Toronto (Ontario).
C. Nalewajko, and L. Marin.
Canadian Journal of Botany, Vol. 47, p 405-413, 1969. 8 fig, 3 tab, 9 ref.

Descriptors: *Plankton, *Algae, *Phytoplankton, *Lake Ontario, *Growth rates, Environmental effects, Photosynthesis, Diatoms, Chlorella, Carbon radioisotopes, Light intensity, Cultures, Radioactivity, Carbon dioxide, Water pollution effects, Water pollution sources.
Identifiers: *Extracellular production, *Carbon fixation, *Excretion, Stephanodiscus tenuis, Asterionella formosa, Melosira binderana, Generatia time, Chlorella pyrenoidosa, Diatom elongatum, Melosira islandica, Nitzschia acicularis, Nitzschia dissipata, Synedra acus, Sinking rates, Grazing pressure, Population density.

Authors present data on relationship between photosynthesis and extracellular production and relative growth rate in four planktonic algae. Three are diatoms abundant in Lake Ontario; the fourth species, Chlorella pyrenoidosa Chick, was included for comparison. All cultures were grown under low light and stirred continuously. At various stages of growth the carbon-14 method was used to measure photosynthesis and excretion on exposure to high

light intensity. Additionally, photosynthesis and excretion were measured during spring (1966) increase of diatoms in Lake Ontario. Growth rates of planktonic algal populations cannot be measured since factors such as sinking and grazing may mask the true rate. However, such data were thought to be useful for comparison with laboratory experiments, particularly since two of the species studied in culture were of quantitative importance in the bloom. In the four species, both carbon fixation and excretion (on basis of ash-free dry weight) increase with relative growth rate of cultures measured in logarithmic (to base 10) units. In natural populations, percentage excretion values are positively correlated with relative growth rates, however, environmental factors may be of relatively greater importance and determine the extent of excretion. (Jones-Wisconsin)

W69-10158

TEMPERATURE OPTIMA FOR ALgal DEVELOPMENT IN YELLOWSTONE AND ICELAND HOT SPRINGS,
Indiana Univ., Bloomington. Dept. of Bacteriology.
T. D. Brock, and M. Louise Brock.

Nature, Vol 209, No 5024, p 733-734, Feb 1966. 2 fig, 7 ref.

Descriptors: *Algae, *Temperature, *Hot Springs, Habitats, Alkaline water, Acidic water, Travertine, Calcium carbonate, Bacteria, Biomass, Chlorophyll, Proteins, Light, Nutrients, Hydrostatic pressure, Carbon dioxide, Cyanophyta, Physiological ecology, Thermal water.

Identifiers: *Yellowstone National Park, *Iceland hot springs, Sinter, Nucleic acid, Sisjothandi (Iceland), Enzyme-substrate complexes, Ribonucleic acid, Orcinol method.

In analyzing environmental factors affecting growth, study of habitats where only a single factor varies is desirable. In hot springs temperature is the only variable and its relation to biological development can be measured directly. In the Yellowstone springs, alkaline, acid, and travertine-depositing, high in calcium carbonate, exhibit the greatest biological development. Over siliceous sinter cones, where constant and uniform thermal gradients may exist, blue-green algae proliferate. Pools were chosen where initial chemical composition of water flowing over all organisms along the thermal gradient is identical. The extent of algal development is influenced by amount and rate of water flow and, since springs differed in this factor, they also differed in algal content, while exhibiting similar thermal gradients. Samples were taken whenever possible from areas having identical amounts and rates of water flow. Chlorophyll content was estimated and ribonucleic acid and protein assays made. These results were expressed showing relationship between temperature of sample and biochemical content per unit area. Species number and composition changed along the gradient. The optimum temperature for algal development in these alkaline springs is 51-56 degrees C. Temperatures were lower in Iceland springs and hydrogen ion concentration higher. (Jones-Wis)

W69-10160

THE HABITAT OF LEUCOTHRIX MUCOR, A WIDESPREAD MARINE MICROORGANISM,
Indiana Univ., Bloomington. Dept. of Bacteriology.
Thomas D. Brock.

Limnology and Oceanography, Vol 11, No 2, p 303-307, April 1966. 2 fig, 7 ref.

Descriptors: *Marine microorganisms, *Habitats, Epiphytology, Marine algae, Ecology, Cultures, Washington, Waves (Water), Connecticut, Rhode Island, Temperature, Nutrient requirements, Physicochemical properties, Physiological ecology, Rhodophyta, Chlorophyta.

Identifiers: *Leucothrix mucor, Morphology, Friday Harbor (Wash), Antithamnion sarniense, Rhodochorton, Bangia fusco-purpurea, Sphaerelaria, Gonidia, Callophyllis haenophylla, Tidal current, Puget Sound (Wash), Long Island

Sound, Narragansett Bay, Cape Reykjavik, Faxfjord, Iceland, DNA base composition.

W69-10163

Leucothrix mucor is a large, widespread marine microorganism with characteristic morphological features recognizable in natural collections. It grows as an epiphyte on marine algae, occurring most extensively on rhodophytes (red algae) and on filamentous green algae. Author describes method of isolation and success in extensive epiphytic growth on algae in the laboratory, concluding that the alga not only provides a substratum for attachment of Leucothrix, but also nutrients for its growth. The algal cultures, which have been maintained through successive transfers made over several months, are apparently not harmed in any way by attachment and growth of L mucor. In nature, a wide variety of filamentous and leafy rhodophytes are colonized with L mucor. Where water is still or slow moving, L mucor is rare, but it occurs in extremely high densities on rhodophytes growing in rapidly moving water. All isolates in pure culture have been remarkably similar in physiological and morphogenetic behavior, having similar temperature optima and nutritional requirements. Six strains have deoxyribonucleic acid demonstrating identical base composition. Thus, the species, as defined morphologically, comprises a homogeneous group of strains physiologically and biochemically. (Jones-Wis)

W69-10161

THE RELATIONSHIP OF THE DISTRIBUTION OF THE DIATOM SKELETONEMA TROPICUM TO TEMPERATURE,

Woods Hole Oceanographic Institution, Mass.

Edward M. Hulbert, and Robert R. L. Guillard. Ecology, Vol 49, No 2, p 337-339, Spring 1968. 2 fig, 1 tab, 38 ref.

Descriptors: *Diatoms, *Temperature, *Distribution, Atlantic Ocean, Washington, Pacific Ocean, Caribbean Sea, Panama Canal, Gulf of Mexico, Growth rates, Light intensity, Neritic, Phytoplankton, Physiological ecology.

Identifiers: *Skeletonema tropicum, Skeletonema costatum, Chromatophores, Latitude 30 deg, Friday Harbor (Wash), South America, Clones, Thalassiosira nordenskioldii, Chaetoceros didymus, Nannachloris, Cyclotella nana, Sargasso Sea, Asterionella japonica, Rhizosolenia setigera, Thalassionema nitzschioides, Cape Hatteras, Cape Cod.

Skeletonema tropicum is distinguished from S costatum in possessing a greater number of chromatophores than the latter. S tropicum is found north of the equator, as far as latitude 30 degrees in the western Atlantic Ocean, whereas the ubiquitous S costatum extends into the colder waters north. Reason for the limited distribution of S tropicum, as determined by growth of unialgal cultures, is its inability to live at temperatures lower than 13 deg C. Such a distribution shows that, although S tropicum extends farther north than previous records indicate, it does not extend north of Cape Hatteras, where winter temperatures are below 10 deg C. Other phytoplankton species isolated from tropical waters are unable to grow at low temperatures. There are apparently southern and northern races of these species. However, Skeletonema tropicum does not appear to occur in northern waters, and this is apparently due to the absence of cold water races. S tropicum, though neritic in distribution, can be carried some distance beyond the continental shelf. Thus, one can speculate that it might be carried beyond latitude 30 degrees to become a resident in coastal water north of Cape Hatteras, if it could withstand cold winter temperatures. (Jones-Wis)

W69-10162

THE APPLICATION OF MICRO-AUTORADIOGRAPHIC TECHNIQUES TO ECOLOGICAL STUDIES,

Indiana Univ., Bloomington. Dept. of Microbiology.

For primary bibliographic entry see Field 07B.

ON CONTROL OF LAKE EUTROPHICATION: EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS-- (IN GERMAN),

Kantonales Laboratorium, Zurich (Switzerland).

E. A. Thomas.

Schweizerischen Vereins von Gas- und Wasserfachmannern, Jahrgang 1953, No 2 and 3, p 1-15. 3 tab, 39 ref.

Descriptors: *Water pollution control, *Eutrophication, *Lakes, Phosphates, Phosphorus compounds, Phosphorus, Nitrates, Limiting factors, Nitrogen, Oligotrophy, Ammonia, Water chemistry, Water pollution effects, Phytoplankton.

Identifiers: *Switzerland, *Chemical limnology, *Limiting constituents, Lake Como (Switzerland), Lake Maggiore (Switzerland), Lake Lugano (Switzerland), Lake Zurich (Switzerland), Mesotrophy.

As shown by culture trials, the growth of algae in investigated lakes is largely influenced by high contents of nitrates and phosphates, whereas elements or compounds present in minute amounts (minimumstoffe) are of little significance. In virgin oligotrophic and partly mesotrophic lakes, not affected appreciably by man's activity, phosphorus appears as a limiting constituent. Depending on varying annual conditions, either nitrogen or phosphorus may become limiting constituents. Appreciable amounts of nitrates and ammonia in eutrophic lakes are confined to the winter period and to the surface layer of water. Aside from the difference between the contents of nitrogen and phosphorus compounds in the surface water layer, the intensity of calcium precipitation provides a criterion of the phytoplankton production. Where phosphorus is a limiting constituent, an increase in its supply will lead to eutrophication of the lake. Where the summer content of nitrate is a limiting constituent, reduced nitrogen fertilization may partly preclude eutrophication; however, the best control even in this case is a drastic reduction of the supply of phosphorus compounds. (Wilde-Wis)

SOME FEATURES OF SALINE LAKES IN CENTRAL WASHINGTON,

Washington Univ., Seattle. Dept. of Zoology; and Washington Univ., Seattle. Dept. of Oceanography. For primary bibliographic entry see Field 02H.

W69-10165

ALGAE AND PHOSPHORUS IN LAKE MINNETONKA,

Minnesota Univ., Minneapolis. Limnological Research Center.

Robert O. Megard.

Limnological Research Center, Minnesota Univ., Minneapolis, Interim Report No 4, 27 p, December 1968. 9 fig, 3 ref. OWRR Project A-016-MINN.

Descriptors: *Algae, *Phosphorus, *Minnesota, *Eutrophication, Pollution abatement, Growth rates, Chlorophyll, Photosynthesis, Chemical analysis, Bacteria, Nutrients, Temperature, Epilimnion, Nitrogen compounds, Sewage effluents, Light intensity, Lakes, Water pollution sources, Water pollution effects, Water pollution control, Nitrates, Nitrogen fixation.

Identifiers: *Lake Minnetonka (Minn), Lake management program, Algal density, Aphanizomenon, Melosira, Lyngbya.

Data indicate that phosphorus is the critical nutrient for algae in Lake Minnetonka, Minnesota, during summer. The relationship between algae and nitrogen was not studied in detail but nitrate is apparently not critical at any time. This is presumably due to synthesis of nitrate from dissolved gaseous nitrogen by dominant algae in summer. Phosphorus probably was not a limiting

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

nutrient in spring, at which time another substance, possibly nitrogen, was limiting. Detailed analyses of nutrient budgets and water balances will be required to determine what must be done to restore Lake Minnetonka, and requisite time and cost of programs. Initial objective of an interim program should be to reduce influx of phosphorus from the watershed. Most of phosphorus comes from sewage effluents, controllable either by advanced treatment or by diversion. Deterioration of the lake will be retarded even if only moderate quantities of nutrients are prevented from entering. All municipalities must cooperate. Lake Minnetonka will improve only when annual nutrient losses exceed influx. Further study can resolve whether advanced sewage treatment with abatement of other sources of nutrients, or sewage diversion, will be required. (Jones-Wis)
W69-10167

OBSERVATIONS ON EXCESSIVE WEED GROWTH IN TWO LAKES IN NEW ZEALAND, Marine Dept. Rotorua (New Zealand).

G. R. Fish.
New Zealand Journal of Botany, Vol 1, p 410-418, December 1963. 1 fig, 2 tab, 7 ref.

Descriptors: *Weed control, *Lakes, Boating, Fishing, Ecology, Arsenic compounds, Herbicides, Temperature, Eutrophication, Rainbow trout, Trout, Brown trout, Bottom sediments, Sampling, Crayfish, Limnology, Sulfates, Dissolved oxygen, Water analysis, Bacteria, Diatoms, Cyanophyta, Snails, Mussels, Worms, Plant tissues, Phytoplankton, Plant growth, Water pollution effects, Water pollution sources.

Identifiers: *New Zealand, Lake Rotorua (N Z), Lake Rotoiti (N Z), *Lagarosiphon* major, *Elodea canadensis*, *Faunas*, *Salmo gairdnerii*, Geothermal activity, *Nitella leonardii*, Freshwater sponges, *Potamopyrgus corolla*, *Physha variabilis*, *Potamopyrgus antipodum*, Chironomid larva, *Retropinna lacustris*, Tolerance, *Hyridella menziesi*, *Paranephros planifrons*.

A water weed, *Lagarosiphon major* (Ridley) Moss, native of South Africa, growing during recent years in New Zealand lakes Rotorua and Rotoiti, has become sufficiently abundant to threaten normal use of lacustrine facilities, including angling and boating. The excessive growth largely results from enrichment of the drainage area by domestic sewage. Data bearing on ecology of the weed are presented from results of a survey made during 1961. Isolated occurrence of *Lagarosiphon* extending to the surface through 40 feet of water have been reported. Usually, this plant reaches the surface only in water shallower than about 8 feet, where growth is sufficiently dense to exclude fish, and sometimes, snails. An arsenical herbicide failed to control weed growth, possibly because of low temperatures of the lake water, or of an acquired tolerance to the poison since high arsenic levels were preexistent in the plants and bottom deposits of the lakes. Such levels probably result from geothermal activity, evident in many places around the shores and often associated with deposition of arsenical salts. Further eutrophication in these lakes is likely to contribute to deterioration of a valued trout fishery. (Jones-Wis)
W69-10168

ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON, Washington Univ., Seattle. Dept. of Zoology. W. T. Edmondson, G. C. Anderson, and Donald R. Peterson.

Limnology and Oceanography, Vol 1, p 47-53, 1956. 3 fig, 1 tab, 27 ref.

Descriptors: *Washington, *Lakes, *Eutrophication, Sewage, Biota, Phytoplankton, Diatoms, Dinoflagellates, Algae, Hypolimnion, Oxygen, Productivity, Phosphates, Chlorophyll, Epilimnion, Effluent, Temperature, Photosynthesis, Carbon dioxide, Depth, Thermocline, Zooplankton, Triponton, Bacteria, Sedimentation, Copepods, Water pollution sources, Water pollution effects.

Identifiers: *Lake Washington (Wash), *Oscillatoria rubescens*, Switzerland, *Peridinium*, *Oscillatoria agardhi*, *Phormidium*, *Aphanizomenon flos-aquae*, *Secchi disc transparency*, *Anabaena lemmermannii*, *Aphanocapsa*, *Bosmina longispina*, Zurichsee (Switzerland), Linsley Pond (Conn), *Bosmina coregoni longispina*.

Lake Washington has been receiving increasing amounts of treated sewage, and appears to be responding by changes in type and quantity of biota. In 1933 and 1950, dominant phytoplankton organisms were *Anabaena* and various diatoms and dinoflagellates, but in 1955, apparently for the first time, large populations of blue-green alga, *Oscillatoria rubescens*, occurred, a species, which constitutes nuisance blooms in many lakes. An interesting ecological problem exists in connection with the two species of *Oscillatoria* in Lake Washington, *O. agardhi* and *O. rubescens*. The replacement of one by another may imply a distinct, but perhaps subtle difference in ecological requirements. A great increase in the hypolimnetic oxygen deficit is considered as evidence of increased productivity; the deficit was 1.18 micrograms per square centimeter per month in 1933, 2.00 in 1950, and 3.13 in 1955. Decrease in oxygen is fairly closely related to increase in hypolimnetic phosphate concentration between measurements, much less closely related to the chlorophyll concentration in the epilimnion. Further study of Lake Washington as its eutrophication proceeds or, if effluents are diverted, of the extent to which the lake regains its former, more oligotrophic, condition will be valuable. (Jones-Wis)
W69-10169

EUTROPHICATION OF LAKES AND RIVERS: ITS ORIGIN AND PREVENTION (IN GERMAN), Kantonal Laboratorium, Zurich (Switzerland).

E. A. Thomas.

Vierteljahrsschrift der Naturforschenden Gesellschaft, Zurich, Vol 107, No 3, p 127-140, 1962. 24 ref. In German.

Descriptors: *Lakes, *Rivers, *Eutrophication, Runoff, Fertilizers, Nutrients, Nitrates, Phosphates, Phytoplankton, Iron compounds, Algae, Plants, Water pollution effects, Water pollution sources, Water pollution control, Limnology, Diversion, Streams.

Identifiers: Aluminum sulfate, Iron chloride, Iron sulfate, *Cladophora* blankets, *Hydrodictyon*, *Macrophytes*.

Runoff, even when deprived of its mechanical and biogenic constituents by purification, provides rich fertilizer for algae and higher plants of streams and lakes. Nitrates and phosphates are particularly important stimulants which induce various harmful consequences. Removal of phosphates from the runoff by the use of suitable chemical reactions constitutes a direct control measure inhibiting eutrophication. The possibility of diversion if dissolved phosphates for production of farm crops is suggested. The method of eutrophication control must be determined by the limnological characteristics of water in question. (Wilde-Wisc)
W69-10170

SEDIMENTS FROM DANISH LAKES, Copenhagen Univ. (Denmark). Geographical Lab. For primary bibliographic entry see Field 02H.

W69-10174

REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA.

Northwestern Univ., Evanston, Ill. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 05G.

W69-10176

STUDIES ON MORPHOGENESIS IN A BLUE-GREEN ALGA. I. EFFECT OF INORGANIC

NITROGEN SOURCES ON DEVELOPMENTAL MORPHOLOGY OF *ANABAENA DOLIOLUM*, Rajasthan Univ., Jaipur (India). Dept. of Botany. H. N. Singh, and B. S. Srivastava. Canadian Journal of Microbiology, Vol 14, p 1341-1346, 1968. 5 fig, 2 tab, 12 ref.

Descriptors: *Physiological ecology, *Environmental effects, *Morphology, *Algae, Aquatic microbiology, Cyanophyta, Essential nutrients, Nitrogen compounds, Ammonia, Nitrates, Nitrites, Nutrient requirements, Nutrients, Phytoplankton, Inhibition.

Identifiers: **Anabaena doliolum*.

Spore germination, heterocyst production, hormogone formation, and sporulation are the morphogenetic stages in development of *Anabaena doliolum*. In basal medium, sporulation is simultaneous while heterocyst formation is sequential. Nitrate-, Nitrite-, and ammonium-nitrogen inhibit sporulation and heterocyst formation, degree of inhibition depending on concentration and source of inorganic nitrogen. Nitrate and nitrite induce lysis which is concentration dependent and circumscribed by time, i.e., up to a certain stage the lytic events are preventable by transfer to basal medium, but beyond this stage they become inevitable and complete lysis occurs even in absence of nitrate or nitrite. Sequential differentiation and spatial relations of heterocysts in a growing filament are characteristic of each nitrogen source and indicative of the polarity involved in gradient of heterocyst formation. (Fitzgerald-Wis)
W69-10177

EXCESSIVE WATER FERTILIZATION, Wisconsin Dept. of Resource Development, Madison. Water Resources Div.

Richard B. Corey, Arthur D. Hasler, G. Fred Lee, F. H. Schraufnagel, and Thomas L. Wirth. Report to Water Subcommittee, Natural Resources Committee of State Agencies, Madison, Wisconsin, 50 p, January 1967. 7 tab, 131 ref.

Descriptors: *Water, *Fertilization, *Eutrophication, Lakes, Streams, Algae, Fish, Wisconsin, Sewage, Trout, Nitrogen, Phosphorus, Detergents, Runoff, Percolation, Roads, Roofs, Precipitation (Atmospheric), Wetlands, Seepage, Industrial wastes, Tertiary treatment, Chemical precipitation, Harvesting, Zoning, Diversion, Dredging, Impoundments, Weeds, Sports, Property values, Taste, Odor, Base flow, Lake Mendota (Wis), Bottom sediments, Municipal wastes, Water pollution effects, Water pollution sources, Water pollution control.

Identifiers: Manure, Madison (Wis), Flushing waterways, Milwaukee (Wis), Chicago (Ill), Artificial circulation, Nuisances.

Deterioration of Wisconsin waters will probably increase. Excessive fertilization will become the important public problem in water resources. Domestic sewage constitutes a major source of nitrogen and phosphorus, apparently the major causative elements of eutrophication. Accelerated use of synthetic detergents accentuates a problem to which many other factors contribute: runoff and underground percolation from rural lands; manure applied on frozen soil; runoff from roofs and roads; 'washing' of the atmosphere by precipitation; and release of nitrogen and phosphorus resulting from development of wetlands for agricultural and urban use. Improved removal of nutrients from sewage appears possible. Adding tertiary treatment for effluents; perfecting use of chemical precipitants; biologically removing nutrients by growing and harvesting algae in effluent lagoons; removing nutrients by modification of activated sludge processes; liquidizing and storing winter manure until spring—all may prove effective. Entire drainage basins, shores and frontages, may require rezoning. Diversion of effluents, flushing waterways with clear water, chemically controlling algae and aquatic plants, dredging shallow portions of lakes, artificially circulating entire lakes, drawing nutrient-rich surplus water from lake bottoms, im-

Waste Treatment Processes—Group 5D

pounding streams and controlling subsequent releases—all show promise. (Jones-Wis)
W69-10178

THE IMPORTANCE OF EXTRACELLULAR PRODUCTS OF ALGAE IN FRESHWATER,
University Coll., London (England). Dept. of Botany.

G. E. Fogg, and D. F. Westlake.
Verh Int Verein Theor Angew Limnol, Vol 12, p 219-232, 1953. 3 fig, 2 tab, 20 ref.

Descriptors: *Algae, *Fresh water, *Peptides, Copper, Iron, Ions, Phosphates, Organic compounds, Toxicity, Chlorophyta, Lakes, Reservoirs, Nitrogen, Growth, Amino acids, Chlamydomonas, Chlorella, Wisconsin, Lake Michigan, Phytoplankton, Diatoms, Ecology, Soil, Cultures, Cyanophyta, Water pollution sources, Water pollution effects.

Identifiers: *Extracellular products, Anabaena cylindrica, Zinc, Xanthophyceae, Bacillariophyceae, Myxophyceae, Complex formation, Growth-promoting properties, Chlamydomonas moewusii, Chlorella pyrenoidosa, Tribonema aequale, Navicula pelliculosa, Lake Mendota (Wis), England, London (England), Esthwaite (England), Loweswater (England), Barnes South Reservoir (England), Windermere North Basin (England), Loughrigg Tarn (England), Basenthwaite (England), Tarn Tarn (England), Solway Firth (England), Little Haweswater (England), Staines Reservoir (England), Gloeotrichia natans, Oscillatoria, Botryococcus, Volvox, Uroglena, Aphanizomenon, Microcystis, Coelosphaerium.

Experiments with partially purified preparations of the extracellular polypeptide, produced during normal growth of the cyanophyte (blue-green alga), Anabaena cylindrica, show that this material forms complexes with various ions including those of copper, zinc, ferric iron, phosphate and certain organic substances. Authors suggest that such complex formation may have biologically important effects, and, as an example, they suggest that complex formation between extracellular polypeptide and cupric ion considerably reduces toxicity of the latter toward Anabaena cylindrica. This may explain the erratic results often obtained with copper sulphate used as an algicide. Algae representing other classes (Chlorophyceae, Xanthophyceae, Bacillariophyceae) also produce extracellular peptide. That relatively substantial amounts of peptide-nitrogen occur dissolved in lake waters has been confirmed for a number of English lakes and reservoirs. Authors suggest that this peptide may originate partially from living algae and that by forming complexes with other dissolved substances, it may exert important effects on growth of aquatic organisms. Specific substances may not be necessary, and in lakes, complex-forming substances derived from organic decay or living algae, may effectively produce the requisite environment for cyanophytes. (Jones-Wis)
W69-10180

CHANGES IN THE OXYGEN DEFICIT OF LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson.

Verh Int Verein Theor Angew Limnol, Vol 16, p 153-158, Dec 1966. 3 fig, 1 tab, 8 ref.

Descriptors: *Washington, *Oxygen, *Fluctuation, Sewage treatment, Solar radiation, Chlorophyll, Productivity, Photosynthesis, Algae, Hypolimnion, Epilimnion, Phytoplankton, Seston, Crustaceans, Diatoms, Chlorophyta, Deposition (Sediments), Watersheds (Basins), Water pollution effects, Cyanophyta, Eutrophication.

Identifiers: *Lake Washington (Wash), *Oxygen deficit, Secchi disc transparency, Myxophyceae, Oscillatoria, Anabaena, Diaptomus ashlandi, Epischura nevadensis, Diaphanosoma leuchtenbergianum, Cyclops bicuspidatus, Reproductive rate.

Records of recent changes in oxygen regime in Lake Washington show that, though increasing

amounts of effluent from sewage treatment plants were received and oxygen deficit rate, in general was higher in 1956 to 1964 than in 1933 and 1950, the increase fluctuated and, in some years, rate was similar to that of 1950. Changes in deficit do not appear to be attributable to corresponding changes in productivity. No clear relation appears between deficit and chlorophyll or solar radiation input. Thus the lake has continued to show signs of enrichment by increased primary productivity and algal abundance, while oxygen deficit and its rate of development during the summer have not changed proportionately. A partial explanation may lie in qualitative changes in character of phytoplankton. A relatively small fraction of the 1950 population consisted of colonial Myxophyceae, whereas in 1961-1964, they dominated the population. The rate of deposition of material to the bottom, whose substances support the oxygen deficit, appears not to have increased correspondingly to productivity or crop. There is no indication that changes in oxygen deficit are attributable to changes in watershed of lake. (Jones-Wis)
W69-10182

CHEMICAL TREATMENT OF OIL SLICKS, A Status Report on the Use of Chemicals and Other Materials to Treat Oil Spilled on Water.
Federal Water Pollution Control Administration, Edison, N. J. Water Quality Lab.

For primary bibliographic entry see Field 05D.
W69-10252

POLYMERS FOR SEWER FLOW CONTROL, The Development and Demonstration of the Use of Polymers to Reduce or Eliminate Sewer Overflows by Flow Energy Reduction.

Federal Water Pollution Control Administration, Washington, D.C.

Available from the Clearinghouse as PB 185951, \$3.00 in paper copy, 0.65 in microfiche. Water Pollution Control Research Series, Report WP-20-22, Aug 1969. 180 p, 36 tab, 75 fig, 10 ref, 4 append. FWPCA Contract No. 14-12-34. Program No. 11020 DIG.

Descriptors: Infiltration, Overflow, Toxicity, Sewers.

Identifiers: *Polymers, *Overflow control, Friction reduction, Economic analysis, Toxicity test, *Sewer lines, Sewer flow control.

Six water-soluble polymers were investigated to determine their effects upon aquatic flora and fauna, flow characteristics of wastewater, and the operation of a wastewater treatment plant. It was found that the polymers and gels, in the magnitudes tested, were not toxic to bacteria, algae, or fish, and did not act as a nutrient for algae growth. Based upon calculations obtained from flow test data, a maximum flow increase of 2.4 times the flow prior to injection could be obtained if a constant head was maintained. Laboratory flow test data indicated that if flow rates were held almost constant prior to and during polymer injection, a reduction in the static head occurred as a result of friction reduction within the fluid. The most effective polymers in providing energy reduction were Polyox Coagulant-701, WSR-301, and AP-30; however, AP-30 required higher polymer concentrations to obtain equivalent flow characteristics. In field tests on a 24-inch diameter line, it was found that polymer concentrations of between 35 and 100 mg/l, decreased frictional flow resistance sufficiently to eliminate surcharges of more than six feet. Based upon an economic analysis, the average annual cost of new construction was approximately five times the cost of using polymers during peak storm-flow periods.
W69-10256

WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RE-

LATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA.
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 03F.
W69-10294

5D. Waste Treatment Processes

WATER REUSE: A TEXAS NECESSITY,
Texas Water Quality Board, Austin.
R. D. Fleming, and H. D. Jobs.
J Water Pollut Contr Federation, Vol 41, No 9, p 1564-1569, Sept 1969. 6 p, 2 fig, 1 tab.

Descriptors: *Water reuse, *Water demand, *Texas, Irrigation water, Industrial water, Municipal water, Waste water treatment, Economics, Water allocation (Policy), Water management (Applied).
Identifiers: Texas Water Plan.

By the year 2020, Texas' estimated 33.5 million people will need 12 mil acre-ft of water for municipal and industrial uses, and over 16 mil acre-ft for irrigation. Because the annual safe yield of ground and surface water is only 20 mil acre-ft development of other water sources is a necessity. To plan for the future need, several processes (desalination, weather modifications, and water importation) are being investigated. To develop the importation idea, the Texas Water Plan was initiated in 1964. This paper describes the main aspects of the plan (water reuse, tapping the Mississippi River, control of irrigation) to help meet Texas' future needs. (Knapp-USGS)
W69-09882

OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN,
Weston (Roy F.), Inc., West Chester, Pa.
For primary bibliographic entry see Field 05G.
W69-10021

OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS,
Manhattan Coll., Bronx, N.Y. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B.
W69-10024

AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH),
Ghent Rijksuniversiteit (Belgium). Inorganic Chemistry Lab.
F. M. Bosch, R. Roels, and L. Michiels.
La Trib du Cebedeu, Vol 22, No 305, p 183-185, Apr 1969. 3 p, 1 fig, 1 tab, 11 ref.

Descriptors: *Water pollution treatment, *Water pollution sources, *Industrial wastes, *Industrial water, *Aerobic treatment, Anaerobic conditions, Carbon dioxide, Acidity, Application equipment, Application methods, Water analysis, Carbohydrates, Calcium compounds, Nitrogen.
Identifiers: *Brewery wastes.

The use of an aerobic method to decrease water pollution by brewery wastes is discussed and a schematic sketch of the apparatus is given. The discussion includes the following: (1) preparatory steps; (2) supply and dosage; (3) measurements and analysis; (4) results; and (5) conclusion. The anaerobic phase destroys carbohydrates without forming a considerable amount of acids. In the next aerobic phase, the acids disappear, as well as a fraction of the nitrogen. At the end of the complete cycle the impurities are almost completely mineralized and can be considered as only slightly biopolluted. (Gabriel-USGS)
W69-10088

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM, Pennsylvania Dept. of Forests and Waters, Harrisburg; and Pittsburgh Univ., Pa.

Jan C. Phillips, Rafael G. Quimpo, and James P. Miller.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Vol 2, Int Ass Sci Hydrol, Publ No 81, p 661-670, 1968. 10 p, 2 fig, 2 tab, 10 ref.

Descriptors: *Waste water treatment, *Water quality control, *Analog models, Dissolved oxygen, Oxygen demand, Streamflow, Low-flow augmentation, Synthetic hydrology, Water management (Applied).

Identifiers: Streeter-Phelps equation.

Waste disposal has conventionally been approached by pre-treating raw waste such that then released into a watercourse during critical streamflow, minimum stream quality standards are not violated. An ideal treatment policy must allow for variations in streamflow and bio-chemical parameters during waste injection. A system consisting of a treatment plant allowing multiple-degree treatment, a synthesized streamflow sequence and storage elements capable of withholding treated effluent for optimal release is simulated in an analog computer. The system is operated for different current values of parameters in the Streeter-Phelps oxygen utilization equation to determine the most efficient operating policy. Results were found to be representative of conditions in large stream of normal velocities. Problems of modeling and simulation are discussed. Refinements on the model are suggested. (Knapp-USGS)

W69-10128

AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, Nevada Univ., Reno. Coll. of Engineering.

For primary bibliographic entry see Field 03F.

W69-10187

WASTE WATER RECLAMATION, LOS ANGELES COUNTY, Colorado Univ., Boulder.

John D. Parkhurst.

IN Water: Development, Utilization, Construction, 5th Western Resources Conference, Boulder, p 61-67, 1963.

Descriptors: *Water reuse, Waste water, Water quality, Financing, Reservoir sites.

Identifiers: *Los Angeles County.

In Los Angeles County, a comprehensive reclamation program could increase the availability supply of water for basin recharge and industrial use by approximately 25 per cent; in 1960 320,000 acre feet of wasted waterflow was a quality that was amendable to reclamation and re-use. The basic difference between sewage treatment and water reclamation is outlined - sewage treatment is seen as the responsibility of the community while water reclamation is viewed as a bonus to the community. Financing of water reclamation projects can be accomplished through accumulated tax funds, revenue bonds, general obligation bonds or purchase contracts. The technology for water reuse, however, is available and ready for present use. (Starr-Chicago)

W69-10197

RESEARCH AND DEVELOPMENT FOR REUSE OF WATER, Colorado Univ., Boulder.

Perry L. McCarty.

IN Water: Development, Utilization, Construction, 5th Western Resources Conference, Boulder, Colo, 1963. p 55-59.

Descriptors: *Water reuse, *Research and development, Public health, Urbanization, Water quality, Water costs.

Identifiers: Reuse of water.

With an anticipated demand of nearly 600 billion gallons per day by 1980, it is expected that at least five of the nation's water resource areas will experience a water shortage. The reuse of water is seen as the answer to ameliorating this problem. While the method of increasing the cost of water could alter water use habits and improve the shortages, effective reuse is recommended as the more desirable method of solving the problem. Three conclusions reached: (1) improved methods of waste treatment using new chemical, physical or biological methods must be devised, with a concentration of research efforts aimed at developing these methods; (2) water quality standards should be compatible with health standards but not so restrictive as to limit the amount of reuse of water; and (3) the role of water resource personnel is seen as engaging in effective communication between researchers, water managers and public officials, and in attracting high-quality people into the field of water resource development. (Starr-Chicago)

W69-10198

ENVIRONMENTAL CONTROL FOR WATER RESOURCES IN OTTAWA COUNTY: PREFEASABILITY REPORT.

Bauer Engineering, Inc., Chicago, Ill.

Bauer Engineering, Inc., Chicago, Sept 1969. 63 p, 8 fig, 6 map, 15 tab, 4 ref.

Descriptors: *Waste water (Pollution), Sewage disposal, Sewage treatment, Programs, Geology, Human population, Urbanization, Animal populations, Land development, Municipal wastes, Industrial wastes.

Identifiers: *Waste water management, Ottawa County, Irrigation-disposal regions, Agricultural areas, Agricultural wastes.

The report suggests a program for Ottawa County, Michigan for collecting sewage, conveying it by pipeline, treating it and storing it, and then distributing the resultant effluent on agricultural land so that both water and nutrients are consumed by crops. Section I introduces two concepts basic to efficient waste water management: (1) wastes as resources out of place, and (2) the replacement of open-ended management systems with closed systems. Section II analyzes the environmental geology of Ottawa County in order to assess the feasibility of developing a plan to manage waste water. Generalized potential irrigation disposal regions are identified. Section III deals with development and population trends in the county in order to determine the extent of the waste problem. Discussion focuses on urban centers, urban sprawl, and agricultural development, including land holdings and animal populations. Section IV turns to waste problems, documenting the relative amounts of and problems associated with municipal, industrial and agricultural wastes. Section V evaluates the potential for waste water management. The section discusses management systems and management regions, and offers major findings and conclusions. Section VI outlines the next steps for program development. (Gossen-Chicago)

W69-10205

CHEMICAL TREATMENT OF OIL SLICKS, A Status Report on the Use of Chemicals and Other Materials to Treat Oil Spilled on Water.

Federal Water Pollution Control Administration, Edison, N. J. Water Quality Lab.

Available from the Clearinghouse as PB-185 947, \$3.00 in paper copy, 0.65 in microfiche. Water Pollution Control Research Series Report, ORD-3, Mar 1969. 20 p. FWPCA Program No 15080.

Descriptors: Oil wastes, Oily water, *Water pollution treatment, Detergents.

Identifiers: Oil spills, *Oil spills-chemical treatment, *Dispersants, Sorbents, *Floating sorbents, *Burning agents, *Sinking agents, *Gelling agents, Dispersant toxicity, Dispersant effectiveness chemical use, Effects.

The effectiveness and potential pollutive effects of chemicals and other materials used to disperse, sink, burn or otherwise dissipate oil slicks are discussed. Agents considered are classed as: dispersants, floating sorbents, sinking agents, gelling agents and burning agents. Since many dispersants are presently available, much experience has been gained with the use of dispersants. However, dispersants should not be used indiscriminately, they may have deleterious effects on the ecology. It is necessary to determine the toxicity and the effectiveness of dispersants *viz-a-viz* the same characteristics of the oil without dispersants. Practical experience with gelling, burning, floating and sinking agents is limited. Some of the many commercial products and natural materials used in connection with recent large oil spills are reported.

W69-10252

JOINT MUNICIPAL AND SEMICHEMICAL PULPING WASTE TREATMENT, A Pilot Study Evaluating Combined Treatment of Domestic Sewage and Weak Semicchemical Pulping and Papermaking Wastes.

Federal Water Pollution Control Administration, Erie, Pa.; and Hammermill Paper Co., Erie, Pa.

Available from the Clearinghouse as PB-185 948, \$3.00 in paper copy, 0.65 in microfiche. Water Pollution Control Research Series, Report ORD-1, 28 ref, 11 append, July, 1969. 138 p, 14 tab, 20 fig. FWPCA Grant No. WPRD-223-01-68. Program No 11060 EOC.

Descriptors: Pilot plants, *Pulp wastes, Municipal wastes, *Sewage treatment, *Activated sludge, Sludge disposal, *Oxygenation, Disinfection, ANNUAL COSTS.

Identifiers: *Erie (Pa), Hammermill Paper Company Laboratories, *Joint Treatment Plant.

The City of Erie, Pennsylvania and Hammermill Paper Company made a study of the joint treatment of domestic sewage and pulp and papermaking wastes. A pilot plant was constructed and operated in a series of controlled experiments. Supplemental studies were conducted in the Hammermill laboratories including the operation of a bench-scale activated sludge plant. It was demonstrated that a joint treatment plant could effectively treat a mixture of domestic sewage and pulp and paper mill wastes from Hammermill's Erie Division. A full-scale joint treatment plant should obtain a BOD removal of approximately 90% in summer months and 80%-85% in winter months. Primary treatment should achieve a 25% reduction in BOD and a 60% reduction in suspended solids. Treatment of mixed wastes by the activated sludge process will require a long solids aeration period and a relatively low BOD to volatile solids loading to avoid high sludge volume indices. The activated sludge process does not reduce the color of the mixed wastes and the final effluent will have about 40 mg/l of suspended solids. The chlorine demand of the final effluent averaged over 60 mg/l. A NH₃-Cl₂ mixture added at a level of 2.61 ppm NH₃ and 15-17 ppm Cl₂ showed promise as disinfectant with coliform counts generally below 1,000/100 ml.

W69-10253

STRAINER/FILTER TREATMENT OF COMBINED SEWER OVERFLOWS,

Federal Water Pollution Control Administration, Washington, D.C.; and Fram Corp., Providence, R.I.

Stephen S. Blecharczyk, and Edward L. Shunney. Available from the Clearinghouse as PB 185 949, \$3.00 in paper copy, 0.65 in microfiche. Water Pollution Control Research Series, Report WP-20-16, July, 1969. 53 p, 26 tab, 6 fig, 14 ref, 1 append.

Waste Treatment Processes—Group 5D

FWPCA Contract No. 14-12-17. Program No 11020 EXV.

Descriptors: Filtration, Sewage effluents, *Filters, Sewers, *Sewage treatment.

Identifiers: *Providence, Rhode Island, *Combined sewer overflows, *Strainers, Overflows, Sewer flow, Synthetic substrate.

The primary objective of this feasibility study was to evaluate the principle of a 'self-cleaning strainer, self-cleaning filter' concept for the treatment of combined sewer overflows. The anticipated goal was to design and construct a prototype system capable of handling up to 1000 gallons per minute with a B.O.D. reduction near 60 percent, and with the capability of automatic operation in remote locations. A combined sewer overflow in Providence, Rhode Island, was sampled and analyzed to determine the type and amount of contaminant discharged into the receiving stream. The average concentration was determined to be nearly equal to pure domestic sewage. It was also determined that the analysis reported for overflows is very dependent on the exact sampling method used. Automatic sampling devices utilizing small diameter tubing do not take a representative sample since the suspended solids distribution is not uniform over the cross-sectional area of the discharging stream. Based on overflow sample analysis data (samples taken manually), a synthetic substrate solution was prepared to evaluate a forced flow self-cleaning strainer for significant operating variables. The strainer and filter systems were evaluated using the synthetic substrate, primary influent to two separate municipal treatment plants, fresh sewage solids and actual combined sewer flow. It was demonstrated that the strainer model produced consistent suspended solids removal rates near 35 percent under highly varying load conditions, at a flux of 25 gallons per minute per square foot. The diatomite study showed operational success could be achieved at a 50 percent organic reduction rate at 4 gallons per minute per square foot of area, but at a minimum estimated operating cost of \$1.50 per 1000 gallons.

W69-10254

POLYMERS FOR SEWER FLOW CONTROL, The Development and Demonstration of the Use of Polymers to Reduce or Eliminate Sewer Overflows by Flow Energy Reduction.

Federal Water Pollution Control Administration, Washington, D.C.

For primary bibliographic entry see Field 05C. W69-10256

WATER POLLUTION AND WASTE CONTROL IN THE TEXTILE INDUSTRY,

P. Brannock.

Textile Forum Vol 25, p 10-13, Dec 1967-Jan 1968. 5 ref.

Descriptors: *Waste water treatment, *Waste disposal, Water pollution sources.

Identifiers: *Textile wastes.

The treatment and disposal of textile effluents in North Carolina are briefly surveyed under the following headings: Evaluation of the pollution problem; Sources and types of textile process wastes; Characteristics and effect of pollution; Determination of a course of action; and Reduction of wastes by in-plant process control. (Livengood-North Carolina)

W69-10257

KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS,

Illinois Univ., Urbana. Dept. of Civil Engineering.

S. K. Banerji, B. B. Ewing, R. S. Englebrecht, and R. E. Speece.

J Water Pollution Control Fed, Vol 40, No 2, Part 1, p 161-173, Feb 1968.

Descriptors: *Activated sludge, *Kinetics, *Aerobic treatment, Aeration, Chemical oxygen demand, Temperature, Degradation (Decomposition), Microorganisms, Carbohydrates.

Identifiers: *Starch, Microbial degradation.

A laboratory-scale study of the kinetics of starch removal in activated sludge systems revealed that first-order kinetics prevail during the initial aeration period, with the removal-rate constant dependent on food-to-microorganism ratio rather than on initial sludge concentration. Removal of total chemical oxygen demand follows zero-order kinetics and depends on initial mixed liquor suspended solids. The effect of temperature on both removal rates is significant. In aerobic systems, further breakdown of starch breakdown products occurs inside microbial cells. Anaerobiosis has no effect on starch degradation under good mixing conditions, but greatly retards total-COD and total-carbohydrate removals. (Livengood-North Carolina)

W69-10258

Biodegradable Surfactants for the Textile Industry,

K. A. Booman, J. Dupre, and E. S. Lashan.

American Dyestuff Repr Vol 56, No 3, p P82-P88, 1967.

Descriptors: *Biodegradation, *Surfactants, *Test procedures, Sulfonates, Foaming, Microorganisms, Aerobic bacteria, Activated sludge, Standards.

Important biodegradability test methods are evaluated and the results obtained in these laboratory tests with various surfactants are reviewed. The degradability of linear alkyl aryl sulfonates has been studied extensively and tests developed. Where data are available field and laboratory results are correlated. (Goodwin and Livengood-North Carolina)

W69-10259

Surface-Active Agents in Textile Processes and Their Effect on Effluents,

W. V. Barnes, and S. Dobson.

J Soc Dyers Colourists Vol 83, No 8, p 313-320, 1967.

Descriptors: *Surfactants, *Biodegradation, *Water pollution effects, *Soaps, Waste treatment, Detergents, Emulsifiers, Bactericides.

Identifiers: Textile processes (General), Alkyl benzene sulfonates, Nonionic surfactants, Cationic surfactants, Anionic surfactants, Antistatic agents, Dyeing auxiliaries, Man-made fiber production wastes, Molecular structure.

Various types of surface-active agents and their applications in textile processing are reviewed, particular consideration being given in the choice of a product for a specific application, to factors such as the biodegradability of the agent and its subsequent influence on effluents, waste treatment, and water pollution. (Goodwin and Livengood-North Carolina)

W69-10260

Biological Treatment of Textile Effluents,

Institute of Water Pollution Control, London (England).

A. I. Biggs.

Chemistry and Industry, No 37, Sept 16, 1967, p 1536-1538.

Descriptors: *Water supply, *Treatment facilities, Economics.

Identifiers: *Biological treatment, *Textile wastes.

A discussion is given of the treatment of wastes from the textile industry. A large number of factories were located to make use of available water supplies and in many cases are still distant from any

large urban conurbation. To offset these difficulties the factories concerned have to undertake the very considerable cost of installing their own biological treatment plant or become a major contributor to the capital cost of building a new sewage works. In the light of the present knowledge on the economics of biological treatment the consequences to the textile industry are depressing. (Livengood-North Carolina)

W69-10261

Versatile Ion Exchange Resins Can Solve Pollution Problems.

American Textile Repr Vol 80, No 9, p 12, 21, and 61, 1966.

Descriptors: *Water purification, *Hardness (Water), Waste water treatment, Treatment facilities, Surface waters, Standards, Corrosion, Flocculation, Iron, Magnesium, Calcium, Bicarbonates, Organic matter.

Identifiers: *Ion exchange resins, Textile wastes.

This paper reports on the treatment of raw textile waters using ion exchange resins. It considers economy of equipment installation in new or remodeled plants. (Goodwin and Livengood-North Carolina)

W69-10263

Purification of Industrial Wastes (in German),

Erich Asendorf.

Chemiker-Ztg, Vol 90, No 16, p 573-578, 1966.

Descriptors: *Waste treatment, Hydrogen sulfide, Dairy industry, *Oil wastes, Phenols, Acids, Metals, Clays.

Identifiers: *Bisulfites, *Fiber wastes, *Textile wastes, Aldehydes, Acetonitrile, Acrylonitrile, Amines, Cyanides, Fluorine compounds, Starch.

Thumbnail descriptions of processes for the following wastes are given; aldehydes, acetonitrile, acrylonitrile, amines, bisulfite, H₂S, HCN, chromic acid, tanning wastes, fibrous materials, F compounds, carbon dust, dairy wastes, oil and petroleum products, pharmaceuticals, phenols, starch manufg., acids, metal ions, textiles, clay, and sugar. (Livengood-North Carolina)

W69-10264

Treatment of Wool Scour Effluent and the Recovery of Wool Grease.

American Dyestuff Repr, Vol 52, No 25, p P949, 1963.

Descriptors: Calcium chloride, *Chemical precipitation, *Soaps.

Identifiers: *Scouring waste, *Wool grease, *Recovery (Waste), Sodium carbonate.

The basis of the process used is the treatment of all the effluent with a solution of calcium chloride (brine) in a sufficient amount to precipitate the soap and sodium carbonate. This breaks the emulsion and the precipitated matter is filtered off by precoated rotary drum vacuum filters. (Livengood-North Carolina)

W69-10266

Knit Goods Finishers and Biodegradable Detergents,

R. H. Beaumont.

Knitting Ind, Vol 85, p 10, 39, 1965.

Descriptors: Biochemical oxygen demand, Detergents, Biodegradation, Treatment facilities, Legislation.

Identifiers: *Finishing wastes, Knitted fabrics, Alkyl benzene sulfonates.

If waste goes through a treatment system, the new detergents are desirable; if not, it may be better to

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

keep biodegradability to a minimum. (Livengood-North Carolina) W69-10267

WOOL SCOUR EFFLUENT TREATMENT AND WOOL GREASE RECOVERY.

Wool Record, Vol 106, p 24, 26, 1964.

Descriptors: Calcium chloride, Biochemical oxygen demand, Waste water treatment, Filtration. Identifiers: *Scouring waste, *Wool, Wool grease, *Recovery (Waste), Chemical composition, Sulfuric acid.

Brief details are given of the use of calcium chloride to break down wool scouring wastes in a British plant. (Goodwin and Livengood-North Carolina) W69-10268

BIOLOGICAL OXYGEN DEMAND (BOD) OF STARCH AND STARCH DERIVATIVES (IN DUTCH),

H. Benninga.
Tex, Vol 20, No 1, p 25-28, 1961.

Descriptors: *Biochemical oxygen demand. Identifiers: *Starch, Starch ethers, Textile wastes chemical modification.

It is shown that the BOD of starch products in textile effluents depends to a great extent upon the degree of chemical modification to which the products were subjected. Etherification reduces the BOD of the starch derivatives. (Livengood-North Carolina) W69-10269

WATER POLLUTION (IN FRENCH).

Lab Essais Chambre Comm Magamet, Vol 2, p 16-22, 1965.

Descriptors: *Effluent treatment. Identifiers: *Wool, Decantation.

Results are reported from a simple installation of two decanting tanks for treating effluent in a Mazamet dewooling plant where water is supplied from a stream that is also the outlet for effluent. (Goodwin and Livengood-North Carolina) W69-10270

A REVIEW OF THE LITERATURE OF 1964 ON WASTE WATER AND WATER POLLUTION CONTROL.

J Water Pollution Control Fed, Vol 37, p 587-646, 735-799, 887-979, 1965. 138 p.

Descriptors: *Waste water treatment, *Sewage treatment, *Analytical techniques, *Standards, *Legislation, Pollutants, Organic compounds, Pesticides, Phenols, Inorganic compounds, Nitrogen compounds, Dissolved oxygen, Biological treatment, Filtration, Activated sludge, Disinfection, Detergents, Sludge digestion, Lagoons, Canneries, Dairy industry, Fermentation, Coal mine wastes, Oil wastes, Pulp wastes, Radioactive waste disposal, Radioactivity techniques, Bacteria, Biology, Radioactivity effects, Water supply, Groundwater, Microbiology, Biochemistry, Groundwater recharge, Sea water, Estuaries, Waste water disposal, Self-purification, Oxygen sag, Surface waters, Textile wastes.

The article discusses analytical methods; determination of organic carbon, pesticides, phenolic compounds, organic compounds, metals, inorganic anions, nitrogen compounds, and dissolved oxygen; laboratory control of sewage treatment; biological filtration; the activated-sludge process; disinfection of sewage and water; effects of synthetic detergents; sludge digestion; disposal and utilization of

sludge; lagoons; re-use of sewage effluents; starch and sugar factories, chemical industries, and textile and wool industry; methods for treatment of radioactive waste waters and recovery of radionuclides; removal of radioactivity from water and sewage; underground and marine disposal of radioactive wastes; uptake of radioactivity by bottom deposits and aquatic organisms; measurement of radioactivity and methods for continuous monitoring; biology of polluted waters; water quality requirements for fish; biological effects of pollution by sewage, detergents, industrial waste waters, and pesticides and weedkiller; algae, fungi, and bacteria in polluted waters; methods for biological estimation of pollution; effects of radioactive pollution; microbiology and chemistry of polluted waters; the oxygen sag and self-purification; use of stream standards; surveys of polluted waters; legislation and control of pollution; effects of pollution on water supplies; pollution of ground water and polluting effects of ground water recharge; pollution of estuaries and sea water; and disposal of waste waters at sea. (Livengood-North Carolina) W69-10271

A REVIEW OF THE LITERATURE OF 1963 ON WASTE WATER AND WATER POLLUTION CONTROL.

J Wat Pollut Control Fed, Vol 36, p 535-572, 659-711, and 791-863, 1964. 164 p.

Descriptors: *Waste water treatment, *Sewage treatment, *Analytical techniques, *Standards, *Legislation, Pollutants, Metals, Nitrogen, Oxygen, Sulfur compounds, Disinfection, Activated sludge, Detergents, Degradation (Decomposition), Sludge digestion, Lagoons, Canneries, Coal mine wastes, Oil wastes, Dairy industry, Fermentation, Chemical wastes, Pulp wastes, Radioactive waste disposal, Biology, Microbiology, Oxygen sag, Self-Purification, Surface waters, Water supply, Water pollution control, Water pollution effects, Estuaries, Sea water.

Identifiers: Textile wastes.

The following topics are discussed: methods of analysis, including determination of metals, nitrogen, oxygen, BOD, organic compounds, sulphur compounds and suspended solids; laboratory control of sewage treatment; treatment of sewage by physical and chemical methods biological filtration, and activated-sludge process; disinfection of sewage; effects of detergents in water and sewage, and studies on degradation of detergents; sludge digestion; disposal and utilization of sludge; lagoons for sewage and waste waters; re-use of sewage-works effluents; treatment of waste waters from canneries, sugar refineries, dairies, meat packing, fermentation, pharmaceutical and chemical works, coal mining and processing, metal pickling, oil refineries, plating of metals, pulp and paper mills, tanneries and textile and wool industry; methods of treatment and disposal of radioactive wastes; biology of polluted water; biological indicators of pollution, microbiology of polluted waters; pollution by chemicals, oxygen sag and self-purification; stream standards; surveys of surface waters; legislation and control of pollution; effects of pollution on water supply; and pollution of estuarine and sea water. (Livengood-North Carolina) W69-10272

EFFLUENT TREATMENT PLANTS: INSTALLATION AT SPINNING WORKS IN DEVON.

Water and Water Eng, Vol 68, p 115, 1964.

Descriptors: *Treatment facilities, Waste water treatment, Cracking, Autoclaves, Hydrogen ion concentration, Sewers. Identifiers: *Scouring waste, *Wool, Steam heating, Wool grease, Effluent treatment.

The important design and operating features of the new plant installed to treat waste waters from the scouring of woollen yarn and cloth at the works of the Buckfast Spinning Company Ltd., Devon, are

described. The waste waters are discharged to a holding tank where the pH value is adjusted and the emulsion is then pumped to an autoclave where it is subjected to steam heating, pressurizing, and cracking. The discharge from the autoclave is collected in another tank, the oils, fats and greases rising to the top and being decanted, stored, and eventually reprocessed. The pH value of the remaining liquor is adjusted before dilution with other waste waters and discharge to the municipal sewer. (Livengood-North Carolina) W69-10273

EFFLUENT TREATMENT AT A YORKSHIRE MILL.

Textile Weekly, Vol 64, No 1, p 509-510, p 533, 1964.

Descriptors: Economics. Identifiers: *Fiber wastes, Effluent treatment.

The Flygt pumping installation described is said to be able to move water heavily laden with textile fibers and has been installed in Britain by a woolen and worsted manufacturer, dyer, and finisher. Installation and running costs were found to be low. In 18 months of operation it is claimed that no repair or servicing costs have occurred. (Livengood-North Carolina) W69-10274

REMOVING DETERGENTS FROM WASTE WATERS: NEW LOW-COST METHODS.

Mod Textiles Mag, Vol 44, No 10, p 44, 1963.

Descriptors: *Ion exchange, Waste water treatment, Detergents. Identifiers: *Recovery (Waste), Sodium hydroxide, Sulfuric acid.

A new 'liquid ion exchange' process developed by General Mills is described. Cook Machinery Company is to market the new system that makes possible the recovery of the reagent for continuous use. The principal chemicals consumed are sulfuric acid and sodium hydroxide. This system can be adapted to many areas where removal of contaminants in discharge water is important. (Livengood-North Carolina) W69-10275

WATER AND WASTES SYSTEM FOR AN 'INSTANT FACTORY'.

Wat. Sewage Wks., Vol 111, p 186-190, 1964.

Descriptors: *Chemical wastes, Dams, *Industrial wastes, *Domestic wastes. Identifiers: *Finishing wastes.

The new textile finishing plant of Pacolet Industries near Blacksburg, South Carolina, uses water from Buffalo Creek, a tributary of Broad River. A low diversion dam has been built at the intake point and water passes to a 1.5-m³ gal. storage tank. Water for emergency supply is stored in an artificial lake, enclosed by an earth dam, which receives storm drainage from the site. Caustic chemicals are recirculated and concentrated before treatment. Industrial and sanitary wastes are treated separately in lagoons and effluent is discharged by a diffusing pipe to Broad River. (Livengood-North Carolina) W69-10279

CHEMICAL PURIFICATION OF VARIOUS INDUSTRIAL WASTE WATERS (IN GERMAN), Willi Ballnus.

Wasser Luft Betr., Vol 8, p 201-204, 1964.

Descriptors: *Waste water treatment, *Cost comparisons, Pulp wastes, Water purification, Sulfates, Iron compounds, Calcium hydroxide. Identifiers: *Textile wastes, Aluminum compounds, Silicone compounds.

Pptn. processes are described for the treatment of waste water from a paper and ceramic-producing industry and a textile plant. Good purification was obtained in the 1st case with A12 (SO₄)₃ and activated SiO₂. Usable results were obtained with FeSO₄ in combination with Ca (OH)₂ and with A12 (SO₄)₃ in the treatment of textile waste water. A so-called 'waste water purification sulfate' gave the same results as A12 (SO₄)₃ but the usefulness of this product has not been completely tested. Costs of chemicals for the individual pptn. processes are given. (Livengood-North Carolina) W69-10280

WASTE-TREATMENT EXPERIENCE REPORTED,

J. L. Brown.

Southern Power and Ind., Vol 79, No 1, p 18-20, 44, 1961.

Descriptors: *Biochemical Oxygen Demand, Domestic wastes, Treatment facilities, Hydrogen ion concentration separation techniques, Filtration, Digestion.

Identifiers: *Starch, *Sodium hydroxide, *Textile wastes, *Desizing wastes.

For treatment of a textile-mill effluent, existing methods were too expensive and didn't solve the problem. The main industrial contaminants were starch and other components from the desizing operation, and a 3% NaOH solution from the cleaning operation. Other plant effluents contributed little to the contamination. A biological purification system was already in use on the domestic sewage from the plant. It was found desirable to take the effluents from the desizing operation and the alkaline liquors separate to the treatment plant. Much of the starch was separated out in the primary clarifier, domestic sewage was treated in a similar unit, and the two effluents were mixed. The wash effluent was stored for about a week in large tanks, and then allowed to flow at a regular rate into the domestic sewage so as to give a pH of 11.4. It was not desirable to add this alkaline solution directly into the starch waste, as some of the starch was converted into solvent form. The effluent from the clarifier was then treated in 1st and 2nd stage filters. Separate digesters are provided for the sludge from the primary and secondary filters. Digestion of the primary filter sludge is very rapid owing to the high starch content. This plant removes 96-98% of the settleable solids; the BOD of approximately 1400-1600 was reduced by 81.2% in January and 98.3% in August. (Livengood-North Carolina) W69-10281

WASTE TREATMENT AT CANNON MILLS,

J. L. Brown.

Textile Inds., Vol 124, No 6, p 78-81, 1960.

Descriptors: *Domestic waste, *Biological treatment, Waste water disposal, Treatment facilities, Alkalinity, Biochemical oxygen demand, Waste treatment, Legislation, Standards.

Identifiers: *Desizing wastes, *Bleaching wastes, *Starch, *Sodium hydroxide, Textile wastes, Peroxide bleaches.

The disposal of domestic sewage from the mills and mill village, as well as certain textile processing wastes from the wet processing plant and slasher rooms, is described. (Goodwin and Livengood-North Carolina) W69-10282

BLEACHERY AND DYEHOUSE WASTE STUDIES,

J. L. Brown, Jr.

American Dyestuff Repr. Vol 44, p 385-386, 1955.

Descriptors: Economics, *Biological treatment, Separation techniques, *Domestic wastes.

Identifiers: *Bleaching wastes, *Dyeing wastes.

A two-year study of the waste produced in the bleachery and dyehouse has been completed. Pilot plant operation is planned to determine the most economical treatment and design factors for construction purposes. The principles involved, based on analysis of the lab studies, will be: (1) Segregation of the waste into 3 components; (2) storage of 2 of these components; (3) blending of the 3 components and domestic sewage in proportions that are suitable for biological treatment. The results of the two year study and theoretical pilot-plant operation are discussed. (Livengood-North Carolina) W69-10283

DETERMINATION OF THE DEGRADABILITY OF SYNTHETIC DETERGENTS,

E. L. Barnhart.

Water Wastes Eng, Vol 34, p 646-648, 1963.

Descriptors: *Biodegradation, *Detergents, *Activated sludge, Test procedures, Treatment facilities, Statistics, Biochemical oxygen demand, Chemical oxygen demand, Alkyl benzene sulfonate.

Sufficient laboratory tests can be performed to define the degradability of synthetic detergents. These tests may be used to determine the overall effect of the syndets on the treatment plants and the receiving streams. From such studies statistical data can be obtained and interpolation to a wide range of conditions is possible. (Goodwin and Livengood-North Carolina) W69-10285

CMC KAYOED STREAM POLLUTION.

Textile Ind., Vol 124, No 10, p 161-162, 1960.

Descriptors: *Biochemical oxygen demand, Cotton, Standards, Temperature, Flow rates.

Identifiers: *Desizing wastes, *Starch, *Carboxymethylcellulose, Slashing.

At the Dan River Mills, Inc., Virginia, 50-60% of the pollution load discharged to the Dan River resulted from the cotton desizing wastes and particularly during the summer with low flows and high water temperatures, the oxygen concentration in the river was reduced below state standards. Experiments showed that the BOD of the waste waters could be reduced by using CMC instead of starch in the sizing process, and this has now been used in full-scale operation for over a year. (Livengood-North Carolina) W69-10287

DISPOSAL OF COMBINED TEXTILE FINISHING WASTES AND DOMESTIC SEWAGE,

G. G. Bogren.

American Dyestuff Repr. Vol 47, p 473-476, 1958.

Descriptors: *Cotton, *Biochemical oxygen demand, Hydrogen ion concentration, Domestic wastes, Trickling filters.

Identifiers: *Finishing wastes.

Five years experience at Sayles Finishing Plants indicates that cotton-finishing wastes having a pH in excess of 10.5 may be treated on trickling filters with a small admixture of domestic sewage, with BOD reductions averaging 50 to 60 per cent. Neutralization of wastes will enable the same trickling filters to reduce BOD 60 to 80 per cent. Mixtures of cotton finishing wastes with a small percentage of domestic sewage. (Livengood-North Carolina) W69-10288

BLEACHERY WASTES TREATED BY NUTRIENTS AND HIGH-RATE FILTER PLANT.

Wastes Eng., Vol 26 p 452-453, 1955.

Descriptors: *Treatment facilities, Sedimentation, Lagoons, *Aeration, *Biological treatment, Filtration, Sludge, Cotton, Alkalinity, Acidity, Nitrogen, Phosphorus.

Identifiers: *Bleaching wastes, *Finishing wastes.

A treatment plant was constructed in 1948 at Mansfield Bleachery, Mansfield, Massachusetts, to provide treatment for the general mill wastes and the alkaline and acid process wastes that are discharged from the cotton-finishing mill. The plant is designed to treat a maximum flow of 1 mgd by primary sedimentation, aeration, high-rate biological filtration and second sedimentation, recirculated to the aeration tank. The final effluent can be discharged to the river, or stored in a lagoon from which it seeps into the ground. It is necessary to add supplementary N and P to the waste waters. Sludge is disposed of in a lagoon. (Livengood-North Carolina) W69-10289

WASTES TREATMENT PLANT FOR COTTON FINISHING INDUSTRY, SAYLESVILLE RHODE ISLAND.

Wastes Eng. Vol 26 p 297, 414, 1955.

Descriptors: *Treatment facilities, *Waste water treatment, Cotton, Sedimentation, Sludge.

Identifiers: Percolating filters, Finishing wastes.

The plant for treatment of the waste waters at a mill of the Sayles Finishing Plant, Inc. at Saylesville, Rhode Island, has recently been greatly enlarged to treat more adequately the heavy mill wastes. High-rate percolating filters now supplement the original low-rate percolating filters. The extended plant consists of primary sedimentation tanks; low-rate percolating filters, cinder filters and high-rate percolating filters; secondary sedimentation tanks; and sludge-drying beds. Maximum capacity is 3.3 mgd. (Livengood-North Carolina) W69-10290

OXYGENATION OF IRON (II) IN CONTINUOUS REACTORS,

North Carolina Water Resources Research Inst., Raleigh.

Charles R. O'Melia.

Water Resources Research Institute Report No. 23, 1969. 53 p, 6 tab, 9 fig, 20 ref. OWRR Project A-022-NC.

Descriptors: *Water quality control, *Water treatment, *Water chemistry.

Identifiers: *Iron oxidation, *Chemical reaction engineering, *Optimization.

The research presented in this report is a case history of the application of principles of chemistry, chemical reaction engineering, and optimization to a problem of interest and concern in water quality control, viz., the oxygenation of ferrous iron by oxygen. Theoretical concepts used in attacking the problem are presented, together with experimental results obtained in laboratory scale continuous stirred-tank reactors. Comparison between theoretical predictions and experimental results is shown to be very good. Implications of the theoretical model in the setting of design standards are discussed. W69-10293

5E. Ultimate Disposal of Wastes

MONTE CARLO SIMULATION OF WASTE DISCHARGE,

Wisconsin Univ., Madison.

For primary bibliographic entry see Field 05B.

W69-09880

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F—Water Treatment and Quality Alteration

5F. Water Treatment and Quality Alteration

TESTING OF WATER SUPPLIES.
For primary bibliographic entry see Field 06E.
W69-10040

PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES, Wisconsin Univ., Madison. Water Chemistry Lab. G. P. Fitzgerald, and M. E. DerVartanian. Applied Microbiology, Vol 17, No 3, p 415-421, March 1969. 1 fig, 4 tab, 19 ref.

Descriptors: *Pseudomonas, *Swimming pools, *Bacteria, *Bactericides, *Chlorination, *Aquatic bacteria, *Aquatic microbiology, Algicides, Bioassay, Disinfection, Environmental effects, Environmental sanitation, Inhibition, Chlorine, Nitrogen compounds, Sewage, Sewage bacteria, Sewage treatment, Water pollution, Water pollution effects, Algal control, Analytical techniques, Aquatic algae.
Identifiers: *Pseudomonas aeruginosa*.

Concentrations of ammonia and the chlorine stabilizer, cyanuric acid, which could be expected in swimming pools, decreased the rate of kill by chlorine (C1) of the potential pathogen, *Pseudomonas aeruginosa*. The effect of cyanuric acid increased as the concentration of C1 decreased, a fact of significance from a public health view. Quaternary ammonium algicides had little effect on the kill rate of C1, but an organic mercury algicide had a synergistic effect with C1 when C1-activity was stressed by the addition of ammonia or the use of 100 times the normal concentration of bacteria. The effect of natural waters, rain, beaches, and swimming pools on the kill rate of 0.5 milligrams C1/liter indicated that a treatment time of one hour or more was required to kill 99.9% of *Pseudomonas* cells at concentration of a million cells per liter. The synergism of C1 and the organic mercury algicide was also demonstrated with these waters and with sewage treatment plant effluents. Author discusses the necessity of developing and using laboratory tests which simulate conditions in swimming pools with heavy loads of swimmers, as opposed to tests in chlorine demand-free conditions. (Fitzgerald-Wis)
W69-10171

SANITARY PROVISIONS.

SC Code Ann secs 35-121 thru 35-124 (1962).

Descriptors: *South Carolina, *Water pollution, *Public health, *Sanitary engineering, Sewage disposal, Wastes, Water purification, Legislation, Legal aspects, Water policy, Administrative agencies, Water supply, Diseases, Environmental sanitation, Portable water, Water quality, Water analysis, Water resources, Water quality control.

Only where towns have no public waterworks system will privies be allowed and then only as approved by the State Board of Health. Water used by hotels or restaurants, when there is no public water supply, must be analyzed by the Board at least twice a year. Cisterns and other receptacles containing standing water must be screened or covered so as to prevent the entrance of flies, mosquitoes, and other disease-carrying insects. (Johnson-Florida)
W69-10300

5G. Water Quality Control

CHEMISTRY OF N AND MN IN COX HOLLOW LAKE, Florida Univ., Gainesville.
For primary bibliographic entry see Field 05A.

W69-09881

ARTIFICIAL Destratification IN RESERVOIRS OF THE CALIFORNIA STATE WATER PROJECT, California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 05C.
W69-09883

DISTRIBUTION OF PESTICIDES IN SURFACE WATERS, Virginia Polytechnic Inst., Blacksburg, Va.
For primary bibliographic entry see Field 05B.
W69-09884

WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN, Southeastern Wisconsin Regional Planning Commission, Waukesha.
Roy W. Ryling.
Southeastern Wis Reg Planning Comm Tech Rep No 4, Nov 1966. 342 p, 66 fig, 17 map, 299 tab, 36 ref.

Descriptors: *Water quality, *Wisconsin, *Data collections, *Water pollution sources, *Land use, *Urbanization, Water chemistry, Water pollution effects, Municipal wastes, Sewage treatment, Planning, Water management (Applied), Water resources development, Regional analysis.
Identifiers: Milwaukee, Southeastern Wisconsin urbanization, Regional planning.

A study of stream water quality in the Southeastern Wisconsin Region was made as part of an intensive effort to adjust regional land use and transportation system development plans to the underlying and sustaining natural resource base. An attempt was made to relate stream water quality to land use development and to forecast such water quality under alternative land use development patterns. Stream water quality data collected in the study are tabulated, present stream water quality within the Region is related to existing major sources of pollution, the effect of stream water quality on various water uses is assessed, and the interrelationships between stream water quality and land use patterns are studied. Tables and water quality graphs present the factual and interpretive data. Forecasts of future stream water quality within the major watersheds of the Region are presented for alternative land use development plans. The assumptions and rationale underlying these forecasts should prove of assistance in anticipating future stream water quality conditions within the Region. Perhaps the most important finding is the close relationship between land use and stream pollution within the Region and the need to plan future land use and water quality control elements simultaneously. (Knapp-USGS)
W69-09947

THE RANGE OF CHOICE IN WATER MANAGEMENT, Resources for the Future, Inc., Washington, D.C. Robert K. Davis.
Baltimore, Maryland, Johns Hopkins Press. 196 p. 1968.

Descriptors: *Dissolved oxygen, *Water quality, Streamflow, Waste treatment, Sewage, Recreation, Reservoirs, Lowflow augmentation, Effluents, Construction, Coagulation, Chemical precipitation, Biological properties, Cost-benefit analysis, Aeration, Input-output analysis, Waste level, Estuaries, Economic feasibility, Flood control, Costs, Political aspects.
Identifiers: *Microtraining, Waste management cost function.

This study dissects a federal study of the Potomac basin and assesses in detail the range of choice for dealing with a major subproblem in the basin, namely that of maintaining suitable levels of dissolved oxygen in the Potomac estuary. It is a

detailed study of the engineering and economics of dissolved oxygen in the Potomac estuary. The author attempts to discover how broad an array of alternative courses of action may be technologically possible in a given water quality management program. He also wishes to study the analytical problems which the study of alternatives present to water resource planners. The obstacles that the institutional or procedural forms of water resource planning present to limit the range of alternatives considered by planners are presented. Finally, the author wishes to use this approach to discern what kind of responsibility must be exercised by political leaders if planners are to be encouraged to explore the range of choice and if the information so developed is to be utilized effectively in policy and program formulation. (Murphy-Rutgers)
W69-09964

COMMENT ON ECONOMY OF WATER QUALITY MANAGEMENT AND POLLUTION CONTROL, Vulcan Materials Co., Birmingham, Ala.

J. E. Wood, III.
In The Fresh Water of New York State: Its Conservation and Use, p 62-64, Wm C Brown Book Co, Dubuque, Iowa, 1967. 3 p. Edited by Hitchcock, Lauren B.

Descriptors: *Water pollution, Water pollution control, Pollution abatement, Costs, Regulation, Conservation, Water quality control, Water management.
Identifiers: *Effluent charges.

The author agrees with the paper being commented on in respect to the immensity of the water pollution problem, both present and future and that, aside from all aesthetic considerations, there are compelling economic justifications for water pollution control and abatement. However, the author questions the propriety of the proposed system of 'effluent charges' to be imposed by the government and paid to governments by polluters. The principal argument against such charges is that if the charge is sufficiently modest to be tolerable, it becomes a purchased license to pollute. On the other hand, if it is set high enough to effectively prevent pollution, it becomes punitive in nature and a poor substitute for direct regulation. It is also argued that the complexity of administration of a system of effluent charges is too great to be practical. (Loeb-Rutgers)
W69-09965

WATER QUALITY CRITERIA.

American Society for Testing and Materials, Philadelphia, Pa.

American Society for Testing and Materials, Philadelphia, Pennsylvania, 1967. 121 p.

Descriptors: *Water quality, Industrial use, Municipal water, Water pollution, Water pollution control, Water utilization, Water supply, Irrigation, Aquatic life.
Identifiers: *Water quality criteria, Agricultural use, Recreational use, Estuarine organisms, Stream quality, Pacific Oyster Embryo Bioassay.

The papers in this volume were presented at the first ASTM National Meeting on Water Quality Criteria held in Philadelphia in September 1966. Federal Water Pollution Control legislation enacted in 1965 requires that the States establish water quality criteria and provide for implementation of quality controls based upon such criteria. These criteria should rely on scientific fact if the public interest is to be served by this legislative directive. The purpose of the papers presented at this meeting was to evaluate the present state of scientific knowledge of quality requirements for water to be used in agriculture, for municipal and industrial supplies, and for recreation. The papers point out both the adequacies and inadequacies of knowledge in the field. Needs for sound scientific data are discussed and of particular interest is the

emphasis on the requirements of adequately accurate, precise, and standardized methods of analysis. (Loeb-Rutgers) W69-09967

STANTON V TRUSTEES OF ST JOSEPH'S COLLEGE (RESPECTIVE RIGHTS OF UPSTREAM AND DOWNSTREAM RIPARIAN OWNERS WHEN UPSTREAM USE IS TO BE NON-RIPARIAN).

254 A2d 597-601 (Me 1969).

Descriptors: *Maine, *Relative rights, *Riparian rights, *Reasonable use, Legal aspects, Sewage, Easements, Water quality, Streams, Colleges, Judicial decisions.

Identifiers: *Non-riparian uses, Injunctions (Prohibitory).

Defendant college is an upstream riparian owner of a lot on a non-navigable stream. The college itself is located on non-riparian property. Defendant planned to pump sewage from the college to the lot for discharge into the stream. Plaintiffs downstream riparian owners sought to enjoin the commencement of the sewage discharge. The court found that plaintiffs had certain rights to the waters of the stream unchanged in quantity and quality. However, plaintiffs' rights were subject to the reasonable riparian uses of other riparian owners. The planned discharge of sewage by defendant was not a riparian use because the stream was not 'subservient' to the land on which the college is located. The reasonable use doctrine cannot be asserted against riparian owners by other riparian owners who plan to use their riparian land for non-riparian purposes. Defendant was not entitled to a non-riparian use which would change the quantity and quality of the water. The injunction was granted. (Keith-Fla) W69-09968

OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN, Weston (Roy F.), Inc., West Chester, Pa. Chia Shun Shih, and John A. DeFilippi. Proc, Fourth Amer Water Resource Conf, N Y, p 754-779, Nov 1968. 26 p, 7 fig, 12 tab, 9 ref.

Descriptors: *Optimization, *River basins, *Water quality control, *Waste treatment, *Dynamic programming, *Design criteria, Mathematical models, Industrial wastes, Municipal wastes, Cost-benefit analysis, Water management (Applied).

Mathematical models which described the interdependency of systems components were used to optimize the overall economic return from water quality management in a river basin. The objective of the study was to present an optimization model which considered the total cost to water users and waste dischargers in a basin, and to identify direct benefits in terms of reduced treatment costs. Two dynamic programming models were presented. The first was a water quality management model that minimized the total costs of both water and waste treatment in the river basin. The second model designed for optimum waste treatment plant design could add an extra cost-saving refinement to the first model. It was felt that better water quality management could be achieved by using first model. The waste treatment plant design model could also be applied independently for normal industrial and municipal waste treatment design problems. (Thiuri-Cornell) W69-10021

WATER SUPPLY, DRAINAGE AND FLOOD CONTROL. For primary bibliographic entry see Field 06E. W69-10057

POLLUTION OF STREAMS. Ark Stat Ann secs 47-801 thru 47-813 (1964).

Descriptors: *Arkansas, *Water pollution, *Administrative agencies, State governments, Water pollution control, Wastes, Waste disposal, Corporations, Permits, Legislation, Public health, Investigations, Surveys, Pollutant identification, Regulation, Standards, Water quality, Sewage disposal.

The Arkansas Game and Fish Commission, in order to prevent pollution, shall have control of waste disposal. The Commission shall promulgate rules, conduct investigations, and establish pollution standards. It is unlawful for any person, municipality, industry, or corporation to discharge waste into any waters so as to endanger public health, fish, or wildlife. The Commission may order such conduct stopped after a hearing. A Water Pollution Control Commission is established within the state Board of Health and is empowered to: enforce the pollution laws; conduct hearings, investigations, and surveys; establish standards; prepare a program to reduce pollution; issue orders regarding pollution; and plan disposal systems. The Commission may cooperate with any other state governments or the United States Government in matters of water pollution. An act which may cause pollution must be submitted to the Commission, and a permit issued before it may be undertaken. The residents of any area may petition the Commission to investigate alleged pollution. (Darragh-Fla) W69-10071

PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE, Akademiya Nauk SSSR, Moscow. Institut Biologii Vnutrennykh Vod. For primary bibliographic entry see Field 05C. W69-10139

COPPER SULPHATE AIR SPRAY CURES LAKE ALGAE PROBLEM, Sewer and Water Engineer, Sudbury (Ontario). D. D. Brouse. Water and Pollution Control, Vol 104, No 4, p 25-27, Apr 1966. 4 fig.

Descriptors: *Copper sulfate, *Algal control, Water supply, Water quality, Water pollution control, Nuisance algae, Taste, Odor. Identifiers: *Air spray, Sudbury (Ontario), Lake Ramsey (Ontario), Algae counts, Threshold odor numbers, Crop-dusting aircraft, Water sampling, Ontario Water Resources Commission, Pest Control Organization of Toronto, Filamentous algae, Navicula, Aphanizomenon, Ontario (Canada). W69-10157

Since 1960, Sudbury, Ontario, bordering Lake Ramsey, has twice experienced severe taste and odor problems in its municipal water supply. Lake Ramsey has a surface area of 2,023 acres, depths to 65 feet, and little outflow. In October 1965, the algae count peaked at 33,400 areal standard units, Aphanizomenon predominating, accompanied by a threshold odor number of 200. Aphanizomenon's ability to withstand winter temperatures necessitated immediate action. On November 6-8, crop-dusting aircraft sprayed 20 tons of copper sulfate over the lake surface resulting in copper content of 0.20 parts per million (ppm). The immediate area of municipal water intake was avoided. By November 14th, the algae count had been reduced to 2,500 and the odor number to 24. On November 22nd, the algae count had rebounded to 5,000 and odor number to 140, while the copper concentration remained 0.20 ppm. In late November, a second treatment brought the maximum average copper concentration to 0.36 ppm. One week later, after freezing over, the lake's algae count was back down to 2,000 and the odor number to 17. By the end of December, the water was satisfactory for municipal use with only slight noticeable odor (algae count: 1,300, odor number: 4). (Ketelle-Wis) W69-10155

CHANGES IN WESTERN LAKE ERIE DURING THE PERIOD 1948-1962, Bowling Green State Univ., Ohio.

For primary bibliographic entry see Field 02H. W69-10156

ALGAE CONTROL WITH COPPER SULFATE, Portland Water District, Maine. W. D. Monie.

Water and Sewage Works, Vol 103, p 392-397, Sept 1956. 7 fig, 8 ref.

Descriptors: *Algal control, *Copper sulfate, Water supply, Reservoirs, Water quality, New Jersey, Temperature, Organic matter, Hardness, Carbon dioxide, Fish.

Identifiers: *Microscopic examination, *Critical temperatures, *Copper dosage, *Copper application methods, Algae identification, Algae counts, Algal growth, Sedgwick-Rafter Method, Treatment timing, Algae control requirements, Threshold odor tests, Asterionella, Aphanizomenon, Synura, Anabaena, Melosira, Mallomonas, Ulothrix, David Monie Test, Summit (NJ), Canoe Brook Reservoir (NJ).

Algal control should be practiced as a preventative measure and not a cure. The important factors of control with copper sulfate are: (1) ability to determine when treatment is necessary, (2) correct dosage of copper sulfate, (3) application aimed for uniform distribution. The first step is algae identification and counting through microscopic analysis, commonly using the Sedgwick-Rafter Method. Water temperature data are useful in revealing critical temperature ranges in which growth of various species is stimulated. Monitoring temperature allows anticipation of period of rapid algal growth and species composition. Timing of treatment and dosage are important considerations, partially dependent on chemical characteristics of water, temperature, and type of organisms. No fixed dosage can be prescribed, but seven factors may be used as guidelines: algal species, amount of organic matter, water hardness, carbonic acid content, temperature, fish species, and total volume to be treated. A simple, practical laboratory test (David Monie Test), developed by the author for determining correct copper sulfate dosage without regard to water temperature and composition and-within limits-the type and amount of organisms present, is described. Finally, bottom topography is critical in determining dosages for achieving equitable distribution. (Ketelle-Wis) W69-10157

REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA, Northwestern Univ., Evanston, Ill. Dept. of Chemical Engineering.

Ronald D. Neufeld, and George Thodos. Environmental Science and Technology, Vol 3, No 7, p 661-667, July 1969. 7 fig, 2 tab, 19 ref.

Descriptors: *Phosphorus compounds, Eutrophication, Nitrates, Ion exchange, Water pollution control, Waste water treatment, Nutrients, Analytical techniques, Adsorption, Water chemistry, Sorption, Hydrogen ion concentration.

Identifiers: *Orthophosphates, *Chemical processes, *Activated alumina, Alumina, Surface chemistry, Colloidal chemistry, Langmuir isotherm, Probability plot.

Authors cite evidence that some biological treatments for reduction of phosphates in waste water treatment, involving the use of activated sludge or algal removal in a controlled environment, do not fulfill rigid requirements for tertiary treatment. Utilizing laboratory-scale fixed beds of activated alumina ranging from 1.97 to 26.0 centimeters in height, they effected removals in excess of 99.9% orthophosphates from aqueous solutions. Initial concentrations of phosphate-ion in feed varied from 10 to 120 milligrams/liter. Experimental evidence indicates that exchange with nitrates present on solid alumina accompanies initial removal of orthophosphates followed by consecutive reaction of phosphate on surface with that in solution to effect further removal. Utilizing

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

parameters empirically determined from their short-bed (1.97 centimeters) experiments, and from breakthrough curves for bed thicknesses of 3.5 centimeters in their long-bed experiments, authors established the relationship: $q = 3.745 c / (1 + 0.0787 c)$, where q is equilibrium capacity of alumina in milligrams phosphate-ion/gram alumina, and c is initial feed concentration of phosphate-ion (conditions: temperature, 71 deg F; c equal to or less than 120 milligrams phosphate-ion/liter). This relationship agrees well with $q=9$ for $c=5$ reported by Yee (1966, J Am Water Works Association, 58:239). (Eichhorn-Wis)
W69-10176

ECONOMIC EVALUATION OF FLOW AUGMENTATION: A SYSTEMS ANALYSIS CASE STUDY,

Northwestern Univ., Evanston. Dept. of Civil Engineering.

Jerry R. Rogers, and Robert S. Gemmell.
Proc 21st Industrial Waste Conference, Purdue University, Lafayette, Ind., May 1966. 19 p, 1 fig, 6 tab, 5 ref.

Descriptors: *Linear programming, *Dissolved oxygen, *Biochemical oxygen demand, *Flow augmentation, *System analysis, Water quality control, Flow.

Identifiers: *Regional waste treatment, Sensitivity analysis, Deoxygenation coefficient.

The 112-mile section of the Fox River below the Chain of Lakes to the confluence with the Illinois River was divided into 46 river sections. There were 24 waste discharges; 16 locks and low dams; and 8 tributaries at the river sections. A case study (of the linear programming procedure developed by Deininger) was successful in minimizing the total cost of regional waste treatment while maintaining pre-set stream quality standards of DO and/or BOD. Lemke's dual simplex procedure and the Thomas step method for DO prediction were incorporated in the systems analysis. Flow augmentation of stored flood waters in Lake Michigan was tested with water quality for various periods of low flow analysis. A sensitivity analysis of the deoxygenation coefficient and the degree of treatment was conducted. The digital computer program is applicable to river basin quality planning and population growth. (Grossman-Rutgers)
W69-10190

DEPOSIT OF SAWMILL WASTE IN WATERS.

Vt Stat Ann Tit 10, sec 951 (Supp 1968).

Descriptors: *Vermont, *Water pollution sources, *Saw mills, *Sawdust, Legislation, Lightweight aggregates, Woodwastes, Mills, Structures, Industrial wastes, Lumber, Pulp and paper industry, Pulp wastes, Water pollution, Banks, High water mark, Legal aspects.
Identifiers: Sawmill refuse.

It shall be unlawful for a person to deposit any sawmill refuse in the waters of any stream or watercourse or on the banks thereof in such a manner as to be washed into the main stream under normal high water conditions. Violators shall be subject to a fine for each offense. (Helwig-Fla)
W69-10222

REUTER V DEPT OF NATURAL RESOURCES (ADMINISTRATIVE FINDING OF EFFECTS UPON WATER POLLUTION AS PREREQUISITE TO ISSUANCE OF DREDGING PERMITS).

168 NW 2d 860-863 (Wis 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Water pollution control, *Permits, Water pollution sources, Dredging, Excavation, Public rights, Public health, Legislation, Judicial decisions, Appeals, Water pollution effects, Bogs, Lake beds, Investigations, Regulation, Water utilization.

Identifiers: Administrative preferences.

Pursuant to statutory enactment, the Department of Natural Resources was given authority to issue permits for the removal of material from the beds of lakes. Legislation creating the Department declared that its purpose was to enhance water quality through regulations and by the giving of preferences to uses not tending to pollute water or tending to minimize pollution. The plaintiffs brought an action for review of a department order granting a permit to dredge a certain 2 acre floating bog. Plaintiffs contended that the preponderating factor in granting the permits was the effect upon water pollution. The trial court upheld the department order. On appeal, the supreme court of Wisconsin held that the statutes required the department to make a specific finding of the effect upon water pollution in any ruling on a petition for a permit. After such a finding, the department could weigh that factor among others considered. The court further held that a mere finding that issuance of a permit was in the 'public interest' was not sufficient. (Harris-Florida)
W69-10242

WATER SUPPLY.

Ind Ann Stat secs 35-2901, 35-2902, 35-2908, 35-2909 (1969).

Descriptors: *Indiana, *Water supply, *Pollution abatement, *Water pollution control, Legislation, Sewage treatment, Sewage effluents, Public benefits, Water utilization, Damages, Remedies, Agriculture, Industries, Operations, State governments, Public health, Legal aspects, Effluents, Administrative agencies.

No person shall deposit into the waters of the state any substance which (1) is deleterious to the public health or to the lawful use of the water by any industry or lawful occupation; (2) adversely affects any agricultural pursuit; (3) lessens or impairs any livestock industry or the use of the water for domestic animals; (4) lessens or impairs or materially interferes with the use of the water by the state or any political subdivision; or (5) destroys or jeopardizes any beneficial animal, fish, or vegetable life in the water. Any person who has suffered or is threatened with damage because of water pollution may bring suit to abate the pollution. Whenever any sewage treatment plant is not producing pure effluent and has made any public water supply impure, the state board may order the offender to appoint a competent person to superintend the operation of the sewage plant. The provisions of this division and the laws relating to pollution of waters and public water supply shall be enforced by the state pollution control board. (Heckerling-Florida)
W69-10246

IMPROVED SEALANTS FOR INFILTRATION CONTROL, The Development and Demonstration of Materials to Reduce or Eliminate Water Infiltration Into Sewage.

Federal Water Pollution Control Administration, Washington, D.C.

Available from the Clearinghouse as PB 185 950, \$3.00 in paper copy, 0.65 in microfiche. Water Pollution Control Research Series, Report WP-20-18, June, 1969. 96 p, 11 tab, 23 fig, 13 ref, 4 append. FWPCA Contract No. 14-12-146. Program No 11020 DIH.

Descriptors: *Infiltration, *Sealants, Leakage, Groundwater, *Sewage.
Identifiers: *Infiltration control, Leaking joints, Polymers, Sewer lines.

The objective of this program was to develop new, more effective sealants for sewer line leaks (leaking joints, cracks and large holes). This purpose was achieved, and all equipments and materials investigated, tested or compared are presented, along with test results, supporting data, conclusions and recommendations. A wide range of candidate

materials was surveyed, and weaknesses of rejected materials were noted. Meanwhile, specific properties of acceptable materials were ascertained and materials having these properties were identified. These latter materials were subjected to tests designed to demonstrate their effectiveness as sealants. Cost/effectiveness of the new sealant materials was compared with that of present sealant materials. It was concluded that infiltration adversely influences sewer system operating costs and effectiveness, and that leakage repair systems are limited in their effectiveness. Several sealants developed during the program were demonstrated to be able to effect strong, permanent repairs. No significant cost increase beyond that experience with present sealers was indicated. Some present sealant application equipment can be modified for use with the new materials, but new equipment designs are described and recommended. Too, long-term field tests of the materials are recommended.
W69-10255

UNION CARBIDE'S BIODEGRADABLE SURFACTANTS FIGHT POLLUTION.

American Textile Repr Vol 80, No 36, 1966. p 25.

Descriptors: *Biodegradation, *Surfactants, *Detergents, Water pollution control legislation, Textile chemicals, Test procedures, Emulsifiers.
Identifiers: Foaming agents.

Union Carbide's biodegradable surfactants for the textile industry are discussed in relation to water pollution. (Goodwin and Livengood-North Carolina)
W69-10262

INVESTIGATIONS INTO THE CENTRIFUGING OF WOOL-SCOURING LIQUORS FOR WOOL-GREASE RECOVERY,

C. A. Anderson, and G. F. Wood.

J Text Inst, Vol 57, p T55-T64, 1966.

Descriptors: Centrifugation, Temperature.

Identifiers: *Wool grease, *Scouring waste, *Recovery (Waste), *Wool, Sludge-discharge centrifuge.

Centrifuges are frequently used for the recovery of grease from wool-scouring liquors, and experiments, were carried out using an Alfa-Laval sludge-discharge centrifuge, type FVK4, to determine the effect of various factors on grease recovery. It was found that percentage recovery was independent of temp. in the range 57 deg - 82 deg C. and of feed rate in the range 1000-1400 gal./hr., but was inversely proportional to the gravity-disk diameter. In general the centrifuge was inefficient at settings that gave very low or very high conc. of grease in the product, the optimal conc. being 15 plus or minus 5%; procedure is described for adjusting the centrifuge for optimal production. (Livengood-North Carolina)
W69-10265

SIMPLE BIO-AERATION KILLS STRONG WASTES CHEAPLY.

Chem Eng, Vol 70, No 1, p 40-42, 1963.

Descriptors: *Aerobic treatment, Treatment facilities, Starch, Domestic wastes, Waste water treatment, Aeration.
Identifiers: *Desizing wastes, Textile wastes, Dyeing wastes.

The prolonged aerobic stabilization process developed by R. H. Souther has now been installed at a plant at Haw River, North Carolina, to treat a mixture of textile waste waters and domestic sewage, and at several other plants in North Carolina and Georgia. The advantages of this process, which can treat strong starch desizing wastes along with dyes and other waste waters are

Techniques of Planning—Group 6A

indicated. The operation of the process is described briefly, and a flow diagram of the plant is given. (Livengood-North Carolina)
W69-10276

TEXTILE INDUSTRY WARS ON STREAM WASTE POLLUTION,

F. Allen.

Southern Textile News, Vol 22, p 1, 2, 10, 11, Aug 1, 1966.

Descriptors: *Pollution abatement, Water pollution control, *Waste water treat, Treatment facilities, Fish, Lagoons, Biochemical oxygen demand. Identifiers: *Textile wastes, Zinc compounds, Recovery (Waste), Sodium hydroxide.

Textile industry efforts to combat stream waste pollution are illustrated with specific examples. (Goodwin-North Carolina)

W69-10277

WATER IN TEXTILE PROCESSING,

P. Bernhard.

Can. Textile J., Vol 82, p 45-52, 1965. 5 ref.

Descriptors: *Water resources, *Standards, Waste water (Pollution), Economic efficiency. Identifiers: Textile processes (General).

Water resources, with particular reference to their characteristics and availability for textile processing operations, are discussed under the following headings: Water resources, qualitative requirements, characteristics of various water resources, water impurities, water economy (in textile plants), economic water distribution in textile plants and pollution. (Livengood-North Carolina)

W69-10278

FACTORS AFFECTING RECOVERY OF WAX FROM WOOL SCOURING LIQUORS,

C. A. Anderson.

Textile Inst., Vol 53, p 401-409, 1962.

Descriptors: Centrifugation, Oxidation, *Effluents, Sludge.

Identifiers: *Scouring waste, *Wool wax, *Recovery (Waste), *Wool, Wool fleece.

In the centrifugal method for the recovery of wax from wool scouring liquors yields are usually low and experiments have therefore been carried out on factors affecting recovery of the wax. It was found that recovery, which is reduced with increased oxidation of the wax, is greater from the scouring of base portions of the fleece than from tip portions. More wax is recovered from liquors from the scouring of lambs, locks and crutching wools than from the fleece wools. In many liquors, the larger drops in the disperse phase are not preferentially recovered by centrifuging; however, vigorous agitation, which reduces the drop size also reduces recovery and in practice, care should be taken to avoid excessive pumping and agitation of the liquors. Excessive use of soap in scouring reduced the yield of wax; this appears to be due to alternations in the composition of the drops and not to any change in size distributions of the disperse phase. Storage of the liquors was found to have no adverse effect on wax yield, although in some cases there is a change in the distribution of wax between the effluent and sludge phases. (Livengood-North Carolina)

W69-10284

AERATION RECOVERY OF LANOLIN FROM WOOL SCOUR LIQUORS,

C. A. Anderson.

Textile Res. J., Vol 30, p 51-57, 1960.

Descriptors: *Aeration, Treatment facilities. Identifiers: *Scouring waste, *Wool, *Lanolin, *Recovery (Waste).

Investigation of the aeration process has resulted in an improved design for a continuous recovery plant. On a pilot scale the design has permitted throughput rates about 2 1/2 times greater than previous designs, with equal recovery efficiencies. (Livengood-North Carolina)

W69-10286

TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT.

Ky Rev Stat Ann sec 220.551, 220.552 (1963).

Descriptors: *Kentucky, *Interstate compacts, *Water pollution control, *Interstate commissions, Legislation, Tennessee, Alabama, Georgia, Mississippi, North Carolina, Virginia, Legal aspects, River basins, Surveys, Water pollution, Water quality, Sewage treatment, Industrial wastes, Water supply, Pollution abatement, Waste treatment, Recreation, Navigation, Waste disposal, Fish conservation, Standards.

The Tennessee River Basin Water Pollution Control Compact is enacted and entered into by the state as a party. The compact is of full force and effect as between the state and any other compacting state. The purpose of the compact is to promote effective control and reduction of pollution in the waters of the basin. An interstate commission and control district is established to survey, study, and report pollution problems. The commission may recommend minimum standards of water quality. The personnel makeup and administrative workings of the commission are specifically provided for. The commission may establish reasonable physical, chemical, and bacteriological standards of water quality for various classifications of use. The commission's powers with regard to pollution abatement are laid out. The commission's powers extends only to situations where pollution does or is likely to affect the quality of water flowing among, between, into, or through more than one party state. The governor is authorized to enter into supplemental agreements with Tennessee for the regulation and abatement of water pollution in common river basins. (Keith-Florida)

W69-10296

INTERSTATE WATER SANITATION BOARD.

Ky Rev Stat Ann secs 220.560, 220.570 (1963).

Descriptors: *Kentucky, *Interstate compacts, *Environmental sanitation, *River basin commissions, Interstate rivers, Interstate commissions, River basins, Legislation, Legal aspects, Administrative agencies, Water quality control.

An Interstate Water Sanitation Board is established. Members of the Board will serve as members of interstate sanitation control commissions created by interstate compacts to which the state is a party. Provision is made for appointment to the Board and for member qualifications. The powers of the Board are those provided for in the aforementioned compacts and all powers necessary to the carrying out of those compacts. All other agencies and officers of the state are given a mandate to cooperate with the Board. (Keith-Florida)

W69-10297

GROUND WATER CONSERVATION.

For primary bibliographic entry see Field 04B.

W69-10298

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES,

Virginia Polytechnic Inst., Blacksburg, Va.

For primary bibliographic entry see Field 05B.

W69-09879

MONTE CARLO SIMULATION OF WASTE DISCHARGE,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 05B.
W69-09880

PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W69-09902

MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER,
Nevada Univ., Reno. Desert Research Inst.
William S. Butcher.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Vol 2, Int Ass Sci Hydrol, Publ No 81, p 714-723, 1968. 10 p, 23 ref.

Descriptors: *Water allocation (Policy), *Water distribution (Applied), *Systems analysis, *Optimization, Linear programming, Dynamic programming, Stochastic processes, Water storage, Water demand, Water utilization, Reservoir operation, Mathematical models.
Identifiers: Water storage system design.

In both the design and operation of a water-storage system, maximum efficiency requires determination of the optimal allocation of the available water. By using water storage, it is possible to allocate water over long times, in addition to allocating it within a time period. Determination of the optimal allocation of water can be approached in several ways, including the various mathematical modeling methods. To illustrate the alternative methods and the limitations inherent in them, a river basin was chosen to test and compare several methods by applying them to the situation. The methods discussed include 2 linear programming and 2 dynamic programming approaches. (Knapp-USGS)

W69-09918

IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL,
All-Union Scientific Research Inst. of Hydrotechnics and Reclamation (USSR).
L. V. Dunin-Barovsky.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Vol 2, Int Ass Sci Hydrol, Publ No 81, p 682-686, 1968. 5 p, 4 ref.

Descriptors: *Planning, *Water management (Applied), *Digital computers, *Operations research, Systems analysis, Optimization, Data processing, Data storage and retrieval, Data collections, Streamflow forecasting, Model studies, Analog models, Mathematical models.
Identifiers: *USSR, Water resources planning.

Subsequent economic development of some districts of the USSR completely depends upon effective planning and management of water resources. Therefore much prominence is given to the working out of mathematical methods and computer application for solution of these problems. Mathematical methods are being introduced into long-term planning, investigation, and design. Methods are being developed for optimal planning of water resource use in river basins and for large regions. The intensive development of mathematical methods and the increasing application of computers in water economy organizations are used in designing a single automatic system for collecting and processing data, planning, and managing water resources. (Knapp-USGS)

W69-09936

Field 06—WATER RESOURCES PLANNING

Group 6A—Techniques of Planning

THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES,
Colorado State Univ., Fort Collins, Dept. of Civil Engineering.

Ignacio Rodriguez-Iturbe.

Colo State Univ Hydrol Pap No 24, Sept 1967, 46 p. Grant GK-1661 (NSF).

Descriptors: *Analytical techniques, *Statistical methods, *streamflow forecasting, *Synthetic hydrology, *Time series analysis, Regression analysis, Synthetic hydrology, Linear programming, Markov processes, Stochastic processes.

Identifiers: *Cross-spectral analysis.

The potentials of cross-spectrum and multiple cross-spectrum for the analysis of hydrological data were studied. Groups of precipitation and runoff stations were selected in different climatic environment and complete cross-spectral analyses were performed between those stations. The coherence and partial coherence functions were used for the study of frequency correlations between the series and they show that there exists a very strong correlation between the annual cycles of the stations. Along the Pacific Coast of the United States the annual cycles in precipitation appears to be basically the same up to distances of 1000 km. Cyclic regression analysis with the use of the gain and phase functions is shown to work correctly in hydrologic time series. This type of regression may be very useful in regions where frequency components account for a large percentage of the variance of the series. Cross-spectral characteristics of the moving average and autoregressive processes are shown to be a powerful tool in testing and analyzing these types of generating processes in hydrology. Special significance has the coherence between two 1st order autoregressive processes which is shown to be equal to a constant independent of frequency. The effects of smoothing or pre-filtering in the cross-spectral properties of 2 series are studied and recommendations made when working with this practice which is frequently used in hydrology. (Knappe-USGS)

W69-09938

SIMULATION OF ECONOMIC SYSTEMS,
Wisconsin Univ., Madison.

Guy H. Orcutt.

American Economic Review Vol 1, No 5, p 893-907, Dec 1960. 15 p, 25 ref.

Descriptors: *Simulation analysis, *Mathematical studies, Computers, Data collections, Statistics, Model studies, Economic analysis, Forecasting, Government, Taxes, Training, Design, Systems analysis.

Identifiers: *Economic systems, *Block-recursive models, Systems control.

Simulation is a general approach to the study and use of models, furnishing an alternative approach to that offered by conventional mathematical techniques. Various uses of simulation are described in Section I of this article (e.g., training uses, design uses, and systems control and forecasting uses). Models and model building are discussed in Section II. The third Section presents various means by which complex, large-scale systems can be simulated. The last section describes a concrete example of simulation of a demographic model of the United States. The author feels that a simulation approach to the study and use of models of economic systems has become essential due to the rapid development of survey research techniques and other improved means of data collection. With increased use of models to study the economic relationships in the water resource area, this article should be of use to the water researcher interested in the microeconomic problems of water resources. (Murphy-Rutgers)

W69-09949

SIMULATION OF INDIVIDUAL AND GROUP BEHAVIOR,
Ford Foundation, New York; and Carnegie Inst. of Tech., Pittsburgh, Pa.

Geoffrey P. E. Clarkson, and Herbert A. Simon.
American Economic Review Vol 6, No 5, p 920-932, Dec 1960. 13 p, 26 ref.

Descriptors: *Model studies, *Simulation, Economic analysis, Statistics, Computers, Microeconomics, Investment, Profits, Cost, Demand, Mathematical studies, Computer programming, Management.

Identifiers: *Aggregation, Duopoly, Microeconomics, Programming.

Simulation is a technique for building theories that reproduce part or all of the output of a behaving system. This paper outlines some methods for using simulation to study various aspects of an economic system. In particular, the author places special emphasis on microeconomic simulation—especially the simulation of individual economic actors and individual firms. A comparison is made between one-period change analysis and simulation. Various forms of simulation are explained, including dynamic macroeconomics, management science and economic decision-making. The uses of computers in simulation are discussed and some examples of microeconomic simulation are given. The author feels that the main advantages of simulation are in the complexity they permit, the possibility of avoiding construction of mathematical models and the new approaches offered to the aggregation problem. Because these problems are often encountered in the economics of water resources this paper should prove useful to the water researcher. (Murphy-Rutgers)

W69-09950

ALTERNATIVE ASYMPTOTIC TESTS OF SIGNIFICANCE AND RELATED ASPECTS OF 2SLS AND 3SLS ESTIMATED PARAMETERS,
Pennsylvania Univ., Philadelphia, Pa.

P. J. Dhrymes.

The Review of Economic Studies, Vol 36, No 106, p 213-226, Apr 1969. 14 p, 9 ref.

Descriptors: *Least squares method, Regression analysis.

Identifiers: *Asymptotic tests, *Two-stage least squares, *Three-stage least squares, Ordinary least squares, Aitken estimators, Classical general linear model.

The purpose of this paper is to put forth an alternative derivation of the two-stage (2SLS) and three-stage (3SLS) least squares estimators. In this context, 2SLS and 3SLS emerge, respectively, as ordinary least squares (OLS) and Aitken estimators in a suitably transformed system. It is shown that 2SLS estimation is (asymptotically) EQUIVALENT TO THE ESTIMATION OF PARAMETERS IN THE FRAMEWORK OF THE CLASSICAL GENERAL LINEAR MODEL. A by-product of this approach is a straightforward proof of the efficiency of 3SLS relative to 2SLS and the derivation of necessary and sufficient conditions for efficiency to materialize. Beyond this, the author derives alternative asymptotic tests of significance for the 2SLS estimated parameters based on the t-distribution with a well-defined degrees of freedom parameter. The results in this article were developed under the assumption that all predetermined variables of the model are exogenous; although it is conjectural that such results are applicable to the case where the model contains lagged endogenous variables. System econometric methods can be used in water research problems and this article generalizes the more complex 2SLS and 3SLS methods into the familiar techniques of least squares and generalized least squares analysis. (Loeb-Rutgers)

W69-09953

ON THE INTERPRETATION OF DISCRIMINANT ANALYSIS,

Columbia Univ., New York.

Donald G. Morrison.

Journal of Marketing Research, Vol 6, No 2, p 156-163, May 1969. 8 p, 3 fig, 5 ref, 1 append, 1 disc.

Descriptors: *Regression analysis, Statistical methods, Computer programs, Classification.

Identifiers: *Discriminant analysis, Linear classification, Statistical significance, Mahalanobis D squared statistic, F statistic, bias.

Many theoretical and applications-oriented articles have been written on the multivariate statistical technique of linear discriminant analysis. However, on a practical level little has been written on how to evaluate results of a discriminant analysis—at least in managerial, as opposed to statistical terminology. This article looks at the problem of evaluation from various viewpoints and thus highlights some features pertaining to other statistical techniques. Statistical methods have been used extensively in the water research area. For example, discriminant analysis and regression analysis are used quite extensively in estimating such things as the demand for outdoor recreation and this article presents a less technical discussion of certain techniques that can be utilized in empirical water research. (Loeb-Rutgers)

W69-09957

CAPITAL BUDGETING OF INTERRELATED PROJECTS: SURVEY AND SYNTHESIS,
Massachusetts Inst. of Tech., Cambridge.

H. Martin Weingartner.

Management Science, Vol 12, No 7, p 485-516, Mar 1966. 32 p, 47 ref.

Descriptors: *Budgeting, *Management, *Capital, *Project planning, Linear programming, Optimization, Capital supply, Research and development, Financing, Resource development, Mathematical models, Costs, Investments, Benefits, Value, Profit, Risks.

Identifiers: *Capital budgeting, *Interrelated projects, Randomness, Resource scarcity, Dynamic programming, Integer programming.

This paper surveys the techniques available to those who must decide on an investment program consisting of a potentially large number of interrelated projects and also subject to constraints on capital and other resources. The author makes use of the techniques of linear and integer programming, dynamic programming and the discrete optimizing procedure of Reiter. These techniques are used to analyze the Lorie-Savage problem of maximizing total net present value of investment alternatives. Interdependent projects with and without budget constraints are subjected to the same analysis. Project interrelationships arising from randomness of outcomes and non-linear utility functions are covered as well as interrelationships arising in research and development budgets. Due to presence of these budgeting problems in much of the water resource area, this article should be of use to the water researcher. (Murphy-Rutgers)

W69-09971

ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION,
Harvard Univ., Cambridge, Mass.

H. A. Thomas, and R. Revelle.

Management Science, Vol 12, No 8, p 296-311, April 1966. 17 p, 5 tab, 2 fig, 8 ref.

Descriptors: *Irrigation, *Agriculture, *Economic analysis, Mathematical studies, Statistics, Water supply, Costs, Demand, Reservoir, Water resources, Capital, Salinity, Agriculture, Investment, Groundwater, Storage, Hydrology.

Identifiers: *High Aswan Dam, *Nile River, *Hydropower, Complementarity.

This paper attempts to describe some analytical methods that will be useful in the multidisciplinary effort to select the best method of operating the High Aswan Dam and developing new resources to speed economic growth and social progress. A mathematical model for computer studies is developed to elucidate and quantify the relations between the variables pertaining to agricultural and

Techniques of Planning—Group 6A

power uses. The model incorporates some of the chief factors affecting efficiency of multipurpose operation for the generation of hydroelectric power and for increasing the agricultural production of the United Arab Republic. It is shown that relatively high proportions of the full potential of the system for irrigation and power generation can be developed to meet requirements of the rapidly developing region. (Murphy-Rutgers) W69-09972

SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL BORROWING,
Auburn Univ., Ala.
Joseph M. Bonin.
Public Finance, Vol XIX, No 2, p 101-113, 1964. 13 p.

Descriptors: *Systems analysis, *Operations research, *Management, *Financing, *Government, Interest rate, Costs, Risks.
Identifiers: *Debt management, State borrowing, Local borrowing, Game theory, Bonds, Critical path, Queuing theory, Suboptimization.

The author wishes to show that systems analysis and operations research techniques may be applicable in studying borrowing problems. Suboptimization is said to be extremely useful but open to the errors of a fixation on a single input, the misuse of ratios, the neglect of spillover effects and higher level criteria. Each of these errors are discussed by the author. The usefulness of the operations research techniques of queuing theory, game theory and the critical path method in analyzing governmental borrowing is covered. California is used as an example for the application of these techniques the author feels these tools should be used in state and local debt management, subject to the limitations stated in the article. Due to the importance of debt financing in government water resource projects, this article should prove useful to the water researcher. (Murphy-Rutgers) W69-09976

CALENDAR - DAY C PM,
Army Construction Engineering Research Lab.,
Champaign, Ill.
L. R. Shaffer.
ASCE, Civil Eng, p 65-68, August 1969. 4 p, 4 tab, 1 fig.

Descriptors: *Critical Path Method, Planning, *Scheduling, Operations, Integrated control measures.

The integration of the Critical Path Method and the Bar Chart Technique to improve planning and scheduling was discussed. The Bar Chart Technique of planning and scheduling allowed for the explicit integrated treatment of the how/when aspects of operation but employed a notation that did not permit defining precisely the relationships among the operations; hence the operations might be assigned improper locations in the project's time frame. The C P M, on the other hand, was founded upon a sufficiently precise notation but its solution process did not allow explicit, integrated treatment of the how/when long/when aspects of an operation. The combining of the notation of C P M and the solution of the Bar Chart Technique was defined as CALENDAR - DAY C P M. Two schedules for the CALENDAR - DAY C P M, the Earliest Start Time (EST) and the latest Finish Time were described. The CALENDAR - DAY C P M provided the precision required in defining operations, while utilizing a solution process wherein the duration of the operation was correlated to the time of the year in which it was performed. (Thiuri-Cornell) W69-10009

PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

John W. Knapp, and Walter J. Rawls.
Water Resources Research Center Bull No 24, Virginia Polytechnic Inst., Blacksburg, Va, p 1-55, April 1969. 55 p, 7 fig, 15 tab, 15 ref.

Descriptors: *Mathematical models, *Investment, *Drainage systems, *Decision making, *Cost-benefit analysis, Design criteria, Planning, Economic feasibility, Geographical regions, Engineeers estimates.

Linear models were developed and used to study the significant factors controlling costs of conventional urban drainage systems. The objective of the study was to find decision making tools which engineers and planners could employ for estimating the cost of alternative sizes of drainage facilities and the degree of protection to be afforded; and for judging the potential for development. Techniques of factor, component, and non-linear analysis were performed with data collected from 100 municipal agencies around the country. The study revealed that design practices as well as geographic areas were important. Physical features, although most important, were usually the fixed, uncontrollable variables. Design factors, on the other hand, were important in both degree and kind. The analysis explained the differences in the design methods and led to the development of equations to predict the cost for various levels of design. (Thiuri-Cornell) W69-10011

CONJUNCTIVE USE OF GROUND AND SURFACE WATERS,
California State Dept. of Water Resources, Los Angeles.

James J. Doody.
J Amer Water Works Ass, Vol 61, No 8, p 395-397, Aug 1969. 3 p.

Descriptors: *Simulation analysis, *Conjunctive use, *Surface-groundwater relationships, *Transmissivity, *Optimization, California, Storage, Sediment yield, Water resources development, Mathematical models, Water management (Applied).

The use of mathematical techniques to obtain a least cost water management plan in California was discussed. A mathematical model was developed to provide a tool with which to simulate the dynamic behavior of the groundwater basin under various plans of operation. Each plan was operationally and economically evaluated. The characteristics most important to the model were the transmissive and storage values of the sediments within the basin; and the basin's geometry and structural boundary. The results of the separate analysis of the groundwater system and of the surface delivery network for each plan of operation were integrated into a coordinated operational study of the surface and subsurface facilities. This enabled the engineers and managers to select the most economical plan of operation. (Thiuri-Cornell) W69-10012

DYNAMIC INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS),
California Univ., Berkeley. Sanitary Engineering Research Lab.

Jona Bargur.
Econ Evaluation Water Part VI, Chap 4, Water Resources Center Contrib No 128, Calif Univ, Berkeley, p 23-36, June 1969. 14 p.

Descriptors: *Input-output analysis, *Economic prediction, *Linear programming, *Decision making, *Planning, California, Water resources development, Leontief models, Constraints, Water demand.

Identifiers: Western States.

The characteristics of dynamic input-output models and the use of dynamic analysis to provide a time-sensitive approach to economic forecasting and planning decisions with regard to utilizing resources were discussed. The discussed models included the Leontief Dynamic Model, the Dorfman Dynamic Model, the Chenery-Clark Model and the

Lange Dynamic Model. The application of a general dynamic model developed for studying the California and Western States water economy was also discussed. The study employed a linear programming technique as an aid to the planning of water resource development. Water was treated as a resource constraint for each of the regions in question, and projections of water demand were made for each economic activity, subject to a given technology of production and investment, and reasonable employment forecasts. (Thiuri-Cornell) W69-10014

ECONOMIC EVALUATION OF WATER PART VI: A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY,
California Univ., Berkeley. Sanitary Engineering Research Lab.

Jona Bargur.
Econ Evaluation Water Part VI, Water Resource Center Contrib 128, Calif Univ, Berkeley, p 1-125, June 1969. 125 p, 1 fig, 24 tab, 110 ref.

Descriptors: *Input-output analysis, *Dynamic programming, *Regional analysis, *Optimization, Model studies, California, Linear programming, Planning, Constraints, Resource allocation, Computers.

Identifiers: Interregional analysis.

The objective of this study was to evaluate the dynamic aspects of an interregional economic model of California and the remaining states of the Pacific and Mountain Region and the application of programming techniques to the resulting empirical model. The elements of interregional, multiregional programming models and dynamic input-output models of major contributors such as Isard, Chenery, Strout and Stevens were reviewed and analyzed. With this background, the Interregional Dynamic Input-Output Programming Model was formulated and its use as an analytical device for regional and interregional water resources planning was reviewed. The constraints of the model were broadened so as to include capital and labor as well as freshwater availability. The optimization aspects were directly related to the computer work dealing with linear programming routines. The optimal solution provided the regional planner with an insight into the expected optimal growth of the different sectors under the assumptions underlying the model and projected growth of final goods and services in the economics of the two regions. (Thiuri-Cornell) W69-10016

STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN,
Texas Univ., Austin; Carnegie-Mellon Univ., Pittsburgh, Pa.; and Office of Civilian Manpower Management (Navy), Washington, D.C.

A. Charnes, W. W. Cooper, R. J. Niehaus, and A. Stedry.
Manage Sci, Vol 15, No 8, p B-365-B-375, April 1969. 13 p, 61 ref.

Descriptors: *Linear programming, *Optimization, *Personnel management, *Model studies, *Multiple-purpose projects, Design.

The assignment model of linear programming was developed and extended to allow for vector optimizations and dynamic interactions between assigned personnel and positions in each of which a variety of possible measures and approaches were explored. Formulations involving people-to-people as well as people-to-position matchings were also examined from the standpoint of organizations in which jobs could be fitted to people or vice versa as well as weighted combinations. Possible uses of such models for dealing with the problems of placing disadvantaged or handicapped persons were noted, but the analysis stopped short of the still

Field 06—WATER RESOURCES PLANNING

Group 6A—Techniques of Planning

further possibilities offered new types of machine-technology and information systems designs. (Thiuri-Cornell)
W69-10018

GEOMETRIC PROGRAMMING: NEW OPTIMIZATION TECHNIQUE FOR WATER RESOURCE ANALYSTS,
Texas A and M Univ., College Station; and Texas Univ., Austin.
Wilbur L. Meier, Robert W. Lawless, and Charles S. Beighler.
Proc, Fourth Amer Water Resources Conf, N Y, p 524-533, Nov 1968. 10 p, 1 fig, 13 ref.

Descriptors: *Optimization, *Mathematical models, *Systems analysis, Digital computers, Water resources, Approximation method. Identifiers: *Geometric programming.

The use of a new optimization technique, geometric programming, was discussed and its theory presented. Geometric programming derived its name from a generalization of the arithmetic-geometric mean inequality. Pioneered by Zener, Duffin and Peterson, geometric programming, permitted the direct solution of a large class of optimization problems which heretofore had to be solved by approximate techniques. Invariance properties, which were discovered as by-products of the solution algorithm, provided insight into the physical system being analyzed. It was concluded that many water resource optimization problems could be efficiently solved using this technique. The advent of computer algorithms for geometric programming promised to make it even more useful in the future. (Thiuri-Cornell)
W69-10020

LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK METROPOLITAN REGION,
Rutgers - The State Univ., New Brunswick, N.J.; Barnard Coll., New York; and Columbia Univ., New York.
George W. Carey, and Leonard Zobler.
Proc, Fourth Amer Water Resources Conf, N Y, p 658-668, Nov 1968. 11 p, 5 fig, 1 tab, 14 ref.

Descriptors: *Linear programming, *Water transfer, *Distribution systems, *Water resources, *Interagency cooperation, Optimization, Water allocation (Policy), Surplus water, Reservoir storage, Public benefits, Mathematical models, Regional analysis.

The objective of the study was to explore the possibilities available within the New York Metropolitan Region for the more efficient distribution of water resources which were already developed, so that the yield to the public could be maximized and reservoir spill minimized, before turning to the development of new extra-regional resources. An interagency quantitative model for water transfer from points of local surplus to points of local deficiency was developed. The topology of the water system was described and the interrelated elements of the system were discussed. A linear programming problem was formulated and solved to allocate regional water in the best way possible according to various alternative criteria sets proposed by the planners. Only a part of the model had been applied to real data. (Thiuri-Cornell)
W69-10023

PLANNING APPROACHES TO WATER RESOURCES DEVELOPMENT AND UTILIZATION IN ISRAEL,
Water Planning for Israel Ltd., Haifa.
A. Wiener.
IFAC, Haifa Symp, Comput Contr Nat Resources, Public Util, p 1-12, Sept 1967. 12 p.

Descriptors: *Optimization, *Resource development, *Systems analysis, *Operations research, *Simulation analysis, Water balance, Mathematical

models, Aquifers, Markov processes, Streamflow forecasting. Identifiers: The Sea of Galilee.

The applications of systems analysis and operation research to the planning and operation of Israel's water system as a whole and to its individual components by themselves were discussed. A simulation model for the national grid was set up in order to test alternative operational procedures, to ascertain trends in the water balance and to define the long term differences and surpluses in storage and conduct capacities. A probabilistic forecast of the countrywide storage system for the next few years was calculated by mathematical techniques. A mathematical Markov model was set up and rules were formulated for optimal control of the single storage reservoir, the Sea of Galilee, during flood. Mathematical models were also developed for determining optimal utilization of an aquifer as an element of a water resource system; for deriving optimum operational rules for the national water resource system and for determining the size of elements within a streamflow utilization project. Methods of solution were based mainly on techniques of mathematical programming and simulation. (Thiuri-Cornell)
W69-10026

ECONOMIC EVALUATION OF WATER: PART 6, A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY,
California Univ., Berkeley. Sanitary Engineering Research Lab.

For primary bibliographic entry see Field 06B.
W69-10087

ECONOMIC EVALUATION OF FLOW AUGMENTATION: A SYSTEMS ANALYSIS CASE STUDY,
Northwestern Univ., Evanston. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05G.
W69-10190

SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE,
Texas Water Development Board, Austin.
Wilbur L. Meier, Arden O. Weiss, Donald E. Evenson, and George K. Young.
Texas Water Development Board Report, Aug, 1969. 1150 p. OWRR-14-01-0001-1975.

Descriptors: *Planning, *Water resources development, *Optimum development plans (Minimum cost), *Computer models, Model studies, Hydrologic models, Operations research, Systems analysis, Networks, Simulation, Optimization (Minimum cost), Linear programming, Sampling.

This research represents a first step towards the development of a computer-oriented planning system for use in the planning of large, multi-basin systems of reservoirs and connecting transfer links (river reaches and pump canals) such as the proposed Texas Water System. Eight interrelated computer programs (four Data Management Programs and four Simulation/Optimization Programs) and an approach for using these programs were developed. The purpose of the Data Management Programs is to provide the user with a convenient means for organizing, in the proper form, most of the data required by the Simulation/Optimization Programs. The purpose of the Simulation/Optimization Programs is to collectively define (1) when to construct proposed reservoirs and transfer links, (2) what should be the maximum capacity of each of the reservoirs and transfer links, and (3) what should be the operating policy for each of the reservoirs and transfer links, both during and after the period in which facilities are being added to minimize the present worth of their construction costs, their operation costs, and their maintenance costs. (Weiss-Texas Water Development Board)

W69-10292

6B. Evaluation Process

GEOLOGY FOR PLANNING IN MCHENRY COUNTY,
Illinois State Geological Survey, Urbana.
James E. Hackett, and Murray R. McComas.
Ill State Geol Surv Circ No 438, 1969. 31 p, 2 fig, 1 tab, 26 ref, append.

Descriptors: *Planning, *Urbanization, *Illinois, *Waste disposal, *Water supply, Geology, City planning, Decision making, Aquifers, Water yield, Data collections, Hydrologic data, Glacial drift, Limestones, Sandstones, Gravels, Sands, Engineering geology, Mineral industry, Farms. Identifiers: McHenry County (Ill).

A study of the geology and natural resources of McHenry County was undertaken to provide the McHenry County Planning Commission with basic data for the formulation of a county plan. The collection and interpretation of the geologic data included the following steps: (1) detailed surficial mapping and subsurface study, correlated with soil mapping and supported by laboratory analysis, to differentiate all geologic units on the basis of composition and physical properties; (2) evaluation of geologic units in terms of their mineral-resource, engineering, and hydrologic properties; (3) preparation of interpretative maps in which areas are graded for specific land uses; and (4) analysis of terrains in which land units are differentiated on the basis of physiography and earth materials and evaluated in terms of their suitability for various land uses. The data developed in the course of these studies are adequate to establish patterns and relationships among the mineral- and hydrologic-resource factors for application to a regional plan. Individual site or local area plans require more intensive, larger scale investigations, generally involving on-site collection of subsurface data from controlled drilling. (Knapp-USGS)
W69-09912

ARKANSAS WATER RESOURCES: SUPPLY, USE, AND RESEARCH NEEDS,
Arkansas Univ., Fayetteville. Dept. of Economics.
For primary bibliographic entry see Field 06D.
W69-09940

WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN,
Southeastern Wisconsin Regional Planning Commission, Waukesha.
For primary bibliographic entry see Field 05G.
W69-09947

SOME NOTES ON THE LINDAHL THEORY OF DETERMINATION OF PUBLIC EXPENDITURES,
Oslo Univ. (Norway).
Leif Johansen.
International Economic Review, Vol 4, No 3, p 346-358, Sept 1963. 13 p.

Descriptors: *Government, *Budgeting, Taxes, Welfare economics, Financing, Economic analysis, Prices, Supply, Equilibrium, Optimization, Total cost, Value, Costs. Identifiers: *Public wants, *Public expenditures, Indifference curves, Pareto optimal, Lindahl.

The Swedish economist, Erik Lindahl, offered a solution to the problem of determining simultaneously the extension of expenditures for satisfying public wants and the distribution of the corresponding tax burden. This article is an attempt to present Lindahl's solution in terms of modern welfare-theoretical concepts and to elucidate some new aspects of the solution. The main problem is seen to be the determination of the amount of public expenditures and how the cost is going to be divided in the society. A solution is attempted using the indifference-curve approach in an effort to

derive the Pareto optimal points. An appraisal is made of the Lindahl solution from the point of view of equity and economic welfare. The author expresses doubts about the basis of Lindahl's theory, i.e. the treatment of public goods entirely in terms of individualistic preference scales. Due to the public good nature of governmental expenditure on water resource development, this article should prove useful to water researchers concerned with allocating costs to beneficiaries and determining the optimum amount of expenditures to be made in water areas. (Murphy-Rutgers) W69-09951

COMPARISONS IN RESOURCE MANAGEMENT,
Resources for the Future, Inc., Washington, D.C.
Henry Jarrett.
Baltimore, Maryland, Johns Hopkins Press, 271 p., 1961.

Descriptors: *Conservation, *Water resource development, *Natural resources, Soil conservation, Multiple-purpose projects, Erosion, Flood control, Planning, Cooperatives, Recreation, Industries, Transportation, Population, Financing, Ecology, Forest management, Cost-benefit analysis, Water supply, Land resources, Watershed, National Parks.

Identifiers: *Sweden, *France, *West Germany, *Great Britain, *Canada.

The book contains a collection of articles on resource management. There are six cases examined, each of which deals with an important problem in both the United States and other countries. The author hopes to discover what useful lessons Americans can learn from foreign experience. In each case the nature of the problem in the U.S. is discussed, the experiences of the other country with it are related and the applicability of the foreign solution to the U.S. problem is brought out. The first three sections deal with problems of national park administration, small forest holdings and preservation of natural areas. Of interest to the water resource planner are the last three sections which deal with: water pollution abatement (the Ruhr district used as an example), the problem of integrating local problems with multiple purpose land and water districts (Ontario, Canada used as an example) and the problems of regional development with land and water development (Southern France used as an example). (Murphy-Rutgers) W69-09952

A NOTE ON THE PARTITIONING OF A SINGLE PRODUCT MARKET INTO TERRITORIES OF OUTLETS,
Pennsylvania Univ., Philadelphia.
Shiv K. Gupta, and Christoph Maier-Rothe.
Journal of Marketing Research, Vol 6, No 2, p 232-236, May 1969. 5 p, 3 fig, 1 tab, 1 ref, 1 append.

Descriptors: *Distribution patterns, Costs, Transportation, Outlets, Prices, Distance, Demand. Identifiers: Transportation costs, Territories, Cost function, Monotonic cost function.

Distribution of a good or service is an essential activity of every business. Distribution means transportation of goods from their source, the manufacturing plant or the warehouse, to their destination, the customer. In this article, the authors consider the effect of transportation costs on the size and shape of the area that any particular outlet serves. Several outlets offer the same product to a customer at some given location. It is assumed that, for a given outlet, price is a function of the distance between outlet and consumer, and the customer accepts the offer with the lowest price. First, the concept is illustrated by determining the territories of two outlets with linear cost functions. Then the results are generalized for n outlets and arbitrary monotonic cost functions. This methodology, when applied in the water area, can be used to estimate the number of customers or the demand of each outlet by integrating a given customer density or

demand density over the respective territories. (Loeb-Rutgers) W69-09955

TECHNOLOGICAL PROGRESS AND MICROECONOMIC THEORY,
California Univ., Los Angeles.

W. Z. Hirsh.
American Economic Review, Vol LIX, No 3, p 36-43, May 1969. 8 p, 12 ref.

Descriptors: *Research and development, *Technology, *Resources, Costs, Financing government, Demand, Incomes, Profit.

Identifiers: *Technological progress, *Productivity, Capital goods, Entrepreneurs, Property rights.

This paper attempts to shed light on the nature of technological progress and of the technologically progressive firm. Since microeconomic theory forms the basis for many decisions in the water resource area the discussion of some special problems faced by economists who seek to make this type of analysis, should prove useful. The basis is laid for the development of model to solve these problems that would allow for: (1) the determination of microeconomic policy by more than one set of preferences, (2) an explicit treatment of the choice of a production technique, (3) the possession of property rights over changes in technology, (4) financing to make specific allowance for sources of economies of scale, and (5) the effect of alterations in demand on expenditures. Methods by which the model may be used with each of these areas are suggested. (Murphy-Rutgers) W69-09959

A NORMATIVE THEORY OF TRANSFERS,
RAND Corp., Santa Monica, Calif.

Edgar O. Olsen.
Public Choice Vol VI, p 41-55, Spring 1969. 15 p, 22 ref.

Descriptors: *Resource allocation, *Optimization, Model studies, Costs, Taxes, Income, Welfare economics, Statistics, *Government supports, Economic analysis, Supply, Demand.

Identifiers: *Transfers, *Optimal output, Normative distribution theory, Pareto optimality.

The author wishes to present a theory which will explain the preferences that justify transfers between individuals through government. The solution to this problem allows benefit-cost evaluations of government programs of a redistributive nature. The theory outlined is in the tradition of Lindahl, Bowen, Musgrave, Samuelson and Buchanan. It differs from these in that the optimal pattern of transfers is treated as part of the problem of efficient resource allocation rather than as a separate problem. The existing distribution of the ownership of productive factors is accepted as a constraint on the maximization problem while retaining interpersonal transfers in cash and in kind. Due to the importance of the governmental sector in the water resource area, this article could aid in theoretical treatments of methods to improve the efficiency of water resource allocation decisions. (Murphy-Rutgers) W69-09960

THE REGIONAL MULTIPLIER--A CRITIQUE,
Glasgow Univ. (Scotland).

Thomas Wilson.
Oxford Economic Papers, Vol 20, No 3, p 374-393, Nov 1968. 20 p, 17 ref.

Descriptors: *Regional analysis, Taxes, Production, Economic impact, Investment, Prices, Government, Forecasting, Income, Economics, Industries.

Identifiers: *Regional economics, *Regional multiplier, *Regional development, Monetary policy, Industrial development, MPC, External economies.

The article attempts to determine the uses and limitations of the regional multiplier as an aid in regional policy. This is an area where the water resource planner often plays an essential part. The theory is elucidated and then modified to take account of secondary investment by firms operating in the market and also of induced public investment. It was found that it is not possible to reduce regional disparities by stimulating expenditure in the undeveloped areas without significant spillovers into developed areas. It was also found that little accuracy has been achieved in making the regional multiplier sufficiently operational to provide accurate estimates of secondary increases in expenditures. There is some possibility of using the regional multiplier as a guide to the physical planning of new or expanding towns. Finally, it was found that the regional multiplier cannot afford any guidance as to the kind of industrial structure that development policy might seek to foster. (Murphy-Rutgers) W69-09961

TAXATION AND RISK-TAKING: AN EXPECTED UTILITY APPROACH,
Norwegian School of Economics and Business Administration, Bergen.

Jan Mossin.
Economica, Vol 35, No 137, p 74-82, February 1968. 9 p, 3 ref, 1 append.

Descriptors: *Risks, *Taxes, Interest rate, Tax rate. Identifiers: *Risk-taking, *Expected utility, *Utility theory, Assets, Portfolio, Tobin, Musgrave, Full loss offset case, No loss offset case.

It is a popular notion that higher taxes tend to discourage risk-taking. In economic theory, however, the conclusions in this respect have been somewhat different. Tobin, in his, 'Liquidity Preference as Behavior Towards Risk,' and Musgrave, in his text, come to the conclusion that an increase in a proportional tax rate will, with full loss offset, increase the holding of the risky asset in a portfolio of a given size. Musgrave's analysis of the no-loss offset case leads to the result that the direction of the effect is indeterminate. In this article these problems are re-examined on the basis of expected utility theory. Without any serious loss of generality, the discussion is restricted to portfolio choices involving two assets only. It is assumed, however, that the yield on one of these is non-stochastic. It may be true that in the real world no such asset exists, but when a general utility function is used this assumption is necessary in order to get a relatively simple measure of risk-taking, simply by using the amount invested in the riskless asset. This type of analysis may be applicable to the water area and the associated investment problems and revenue requirements necessary for financing water development projects. (Loeb-Rutgers) W69-09963

THE FRESH WATER OF NEW YORK STATE: ITS CONSERVATION AND USE.
State Univ. of New York, Buffalo.

Dubuque, Iowa, Wm C Brown Book Co, 1967. 255 p. Hitchcock, Lauren B (Editor).

Descriptors: *Freshwater, *Conservation, *New York, *Water resources, *Water pollution, *Energy, *Great Lakes, *Planning, Administration, Water management, Water pollution control, Limnology, Economics, Governments, Streams, Rivers, Lakes, Water quality control, Hydroelectric power, International Joint Commission, Legal aspects, International waters, River basins, Water quality.

Identifiers: Pollution causes, Urban planning, Political environment, Physical environment, Steam power, Nuclear power generation, Grand Canan Concept, Canada.

This volume is made up of the papers presented at a symposium held at the State University of New York at Buffalo. While directed primarily to the challenges confronting New York State, in the

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

water area, much of the discussion applies equally to current problems existing nationally and abroad. Major emphasis has been placed on man's needs—the goals toward which we must strive. An able summation is given of where we stand today, which should resolve some uncertainties, crystallize public opinion, and alert those in government and community life who may still view water problems with a degree of apathy. The symposium brought together representatives of virtually all fields concerned with water resources such as pollution causes and control, water resources management, limnology, hydrology, economics, urban planning, and government. These proceedings provide a comprehensive view of a major problem of society. There emerged the inescapable inference that not much will be accomplished until the federal government finances a much larger position of the multi-billions required to construct municipal and industrial treatment works, paralleling the country's experience in its expanded program of highways. (Loeb-Rutgers) W69-09969

MUNICIPAL WATER FROM WESTERN RIVERS

American Society for Testing and Materials, Philadelphia, Pa.

L. K. Cecil.

In Water Quality Criteria, p 5-12, American Society for Testing and Materials, Philadelphia, Pennsylvania, 1967. 8 p, 24 ref.

Descriptors: *Municipal water, Irrigation, Rivers, Water pollution, Water quality, Brines, Turbidity, Nutrients, Activated carbon, Algae, Evaporation, Herbicides, Pesticides, Mississippi River, Dams, Flood control.

Identifiers: *Western Rivers, Irrigation runoff, Power production.

Western rivers are considered to include the Mississippi and its western, but not eastern, tributaries, and all other rivers to the Pacific Coast. The diverse character of these rivers is well documented. Turbidity cannot be used as a common denominator, for some of these rivers have so little turbidity that the water needs no clarification for municipal use. However, man-made pollution may become a common denominator, considering such practices as airplane spraying of remote forest areas with pest control chemicals. The opening of vast areas of the semi-arid West to agricultural production required the construction of dams to even out the flow so water for irrigation would be assured. These dams were made large enough for flood control and power production. Thus, many Western rivers must be considered as rivers interspersed with very large lakes. The influence of these lakes as they affect the suitability of the river water for municipal use is considerable. Sophisticated analytical tools are needed to help the purification plant operator control treating systems and evaluate feasible economic alternatives for given water objectives. (Loeb-Rutgers) W69-09970

ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT

Colorado State Univ., Fort Collins.

Stephen C. Smith, and Emery Castle.

Ames, Iowa, Iowa State University Press. 463 p. 1965.

Descriptors: *Economic analysis, *Water resource development, Direct benefits, Indirect benefits, Flood control, Project planning, River basin development, Irrigation, Costs, Cost sharing, Groundwater, Productivity, Income, Cost allocation, Planning, Humid areas, Cost-benefit analysis, Treaties, Welfare economics.

Identifiers: *Economic development, Bureau of Reclamation, Assessments, Quantification, Water rights.

This book is a collection of articles on water resource development. The theoretical and practi-

cal issues of benefit-cost analysis are considered as well as the question of budget allocation as it relates to investment in water resources development. The relationship between economics and engineering is brought out. A section is devoted to the various aspects of quantification in the analysis of public investment in water resources economics. The area of financial responsibility is covered with concentration on the problems of pricing and costing. The relation between economics and water law is dealt with and concepts of water-rights, beneficial-use criteria and state and federal government roles are discussed. The last section of the book deals with the problems of increased urbanization of the economy as it relates to water organizations and water rights along with the question of political decision making in this area. (Murphy-Rutgers) W69-09973

REGIONAL ECONOMICS: A SURVEY

Harvard Univ., Cambridge, Mass.

John R. Meyer.

In Surveys of Economic Theory Vol 11, N Y St Martin's Press, p 240-271, 1965. 32 p, 130 ref.

Descriptors: *Economics, *Regional analysis, *Economic analysis, Programming, Income, Industrial production, Government, Transportation, Input-output analysis, Mathematical studies, Prices, Linear programming, Taxes.

Identifiers: *Nodal regions, *Economic development, Gravity model analysis, Location theory, Multiplier theory, Hypothesis testing.

This article seeks to describe the developments in the relatively new area of regional economics, including both its stimuli and conceptual precursors. The definitional problems of regional economics are considered in the first section. In section two a thorough consideration of the policy-problem stimuli is undertaken. The next section treats the theoretical foundations of regional economics, as taken from general economic theory. In Section IV there is a discussion of the different approach to regional economics that have emerged in actual regional studies. The author feels that regional economics is incomplete in a number of important respects. There should be a redirection of effort away from the design of broad conceptual frameworks and accumulation of regional income accounts towards the formulation and testing of behavioral hypothesis. The importance of regional analysis in water resources makes this article of interest to the water researcher. (Murphy-Rutgers) W69-09975

NEW HORIZONS IN WATER RESOURCES ADMINISTRATION

Resources for the Future, Inc., Washington, D.C.

Irving K. Fox.

In Public Administration Review Vol XXV, No 1, p 61-69, March 1965. 9 p.

Descriptors: *Water resource development, *Government, *Watershed management, Economic analysis, Welfare economics, Investment, Technology, Government, Water pollution, Federal government, Flood damage, Water supply, Economic efficiency, Cost, Indirect benefits, Interest rate, Values, Irrigation, Demand, Institutional constraints, Systems analysis, Market, Political aspects.

Identifiers: *Water resource administration, Watershed programs, Regional water agencies.

The author tells of the magnitude of research in the area of water resources and gives the changes in the public water resource policies of the last fifteen years. He reviews welfare theory, the problems in water resource investments, and the policy-institutional framework within which decisions are reached. To foster efficient management and use of water resources in the public interest the author proposes: (1) policies which make use of market-type mechanisms to operate within public policy objectives; (2) restructuring the pattern of policy to allow politically-responsible resolution of policy

issues; and (3) making greater use of various types of checking arrangements and countervailing influences to foster efficiency on the part of the institutions which supply water services. He concludes that technical economic progress has surpassed that on the administrative side and proposes the above policies for a more effective governmental water resources policy. (Murphy-Rutgers) W69-09977

ECONOMICS AND THE ADMINISTRATION OF NATIONAL PLANNING

Yale Univ., New Haven, Conn.

Charles E. Lindholm.

In Public Administration Review, Vol XXV, No 4, p 274-283, December 1965. 10 p.

Descriptors: *Planning, *Input-output analysis, *Economics, Systems analysis, Statistics, Industrial production.

Identifiers: *Market mechanism, *Public administration, *Central planning, Laissez-faire, Decentralization, Socialism, Development planning.

The contribution of economics to national economic planning is obvious. This article outlines the significance of accounting in national planning and the growth in understanding the market mechanism. The manner in which the market mechanism can be used as a device for planning is discussed as well as the way central planning operates. There is an explanation of how development may be achieved through various manipulations performed on the market mechanism. The study of the market mechanism is central to the study of plan administration since the market is the primary instrument for this planning. The article, especially the sections on planning and central planning, has particular relevance for the water researcher since it gives the basics of much of the theory behind the governmental planning of water resource policy. (Murphy-Rutgers) W69-09978

CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS

California Univ., Berkeley.

S. U. Ciriacy-Wantrup.

In Economics and Public Policy in Water Resource Development, Ames, Iowa State University Press, p 251-271, 1965. 21 p, 33 ref. Edited by Stephen C. Smith and Emery N. Castle.

Descriptors: *Water rights, *Water resources development, *Cost-benefit analysis, *Riparian rights, Water utilization, Watersheds, Investment, Groundwater, Flow, Rigidity, Water allocation, Water law, Flexibility, Economics, Income.

Identifiers: *Quantitative techniques, *Macroanalysis, *Steiner model, *Activity analysis, Theory, Programming models, Political structure.

The article evaluates quantitative techniques in areas of application with emphasis on possible usefulness in decision-making situations. In water development and allocation, decisions are made both by the government and the private sector with more than one objective. These goals can be economic and non-economic; economic efficiency is usually primarily emphasized due to the availability of quantitative techniques. This often gives inadequate treatment to other objectives in the investment of public funds in water resources development. Although formal quantitative techniques are not a panacea, they should be encouraged since activity analysis of this type can improve on traditional planning procedures in numerous problems where objectives other than economic efficiency are unimportant. Further, such systematic evaluation procedures should lead to an improvement in data, as well as highlight the loss of efficiency in an existing situation. This implies that if the efficiency aspects of problem are known, a better evaluation of the other objectives is permitted. (Murphy-Rutgers) W69-09980

ACTIVITY ANALYSIS IN WATER PLANNING,
Oregon State Univ., Corvallis.

Emery N. Castle.

IN Economics and Public Policy in Water Resource Development, Ames, Iowa State University Press, p 171-185, 1965. 15 p, 1 tab, 23 ref. Edited by Stephen C. Smith, and Emery N. Castle.

Descriptors: *Water project planning, *Efficiencies, *Decision-making, *Water resources, Income, Measurement, Systems analysis, Canals, River basins, Watersheds, Reservoirs, Irrigation, Input-output analysis, Cost sharing, Flood plain zoning, Productivity, Recreation.

Identifiers: *Quantitative techniques, *Macroanalysis, *Steiner model, *Activity analysis, Theory, Programming models, Political structure.

This article deals with the relations between economics and law. As 'social engineering' law should define social optima, while economics should explain why and how far certain conditions decisively influenced by law facilitate or impede an increase of national income, pointing out the features of conflict situations and the probable consequences of changes in statutes, judicial decisions and administrative regulations. These consequences may be in quantitative terms or in terms of direction, magnitude, and rates of change. A beginning step to implement this law/economics relationship is mutual understanding of the interpretation and application of key concepts used as economic criteria. In water law, these would be security and flexibility of water rights. Since law is essentially a normative discipline, both normative and positive economics can contribute to this mutual understanding. Positive economics and law have many complementary relations, the exploration and strengthening of which will benefit both disciplines. Due to the treatment of water law in this article, it is of interest to water resource researchers. (Murphy-Rutgers)

W69-09982

ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES,
Resources for the Future, Inc., Washington, D.C.

Irving K. Fox, and Orris C. Herfindahl.

American Economic Review Vol 54, No 3, p 198-206, May 1964. 9 p, 9 ref.

Descriptors: *Efficiency, *Water resources, Demand, River systems, Investment, Government, Costs, Cost-benefit analysis, Benefits, Marginal costs, Marginal benefits, Discount rate, Industrial water, Irrigation, Flood control.

Identifiers: *Corps of Engineers, Bureau of the Budget, Production function.

This article discusses the problem of how an efficient allocation of water resource investment can be approached more closely, given that the objective is to increase national income. It involves an assessment of the results of existing practices within the federal government upon efficiency. Thus, the key federal policies which bear on efficiency are examined. In addition reports of the Corps of Engineers on projects authorized by Congress in 1962 for construction are analyzed and a comparison is made between Corps projects authorized in 1962 with those of 1950. By this comparison the authors are able to offer insights into the working and results of the system for investment decision making. The benefit-cost evaluation practices are evaluated in terms of the marginality principle, the selection of discount rates and the success in these projects of estimating the demand functions for services derived from water. The authors recommend that to improve efficiency in satisfying demands for water services greater reliance should be placed upon charges and prices in the allocation process. An independent audit of planning activities is also recommended. (Murphy-Rutgers)

W69-09983

INTERREGIONAL INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS),
California Univ., Berkeley. Sanitary Engineering Research Lab.

Jona Bargar.

Econ Evaluation Water Part VI, Chap 3, Water Resources Center, Contrib No 128, Calif Univ, Berkeley, p 11-22, June 1969. 12 p, 1 tab.

Descriptors: *Input-output analysis, *Resource allocation, *Linear programming, *Regional analysis, *Water resources development, Leontief models, Public benefits, Economic feasibility, California, Evaluation, Optimization.

The study reflected a search for criteria for the evaluation of public policy in the development of water resources in California and the Western States. The objective was to optimize water resources management and develop the greatest benefit to the public. Interregional input-output and linear programming models were reviewed. The input-output models included the Leontief Balanced Model, the Isard Model and the Chenery-Moses Model. The interregional linear programming models included the Isard Linear Programming Model and the Stevens Model. The linear programming models were found to explicitly consider the dynamic element of the economic system. A dynamic interregional input-output programming model was developed and used for analyzing the optimal resource allocation. The model made it possible to establish reasonable projections of future economic development of the multiregional system with preassigned water and labor endowments. (Thiuri-Cornell)

W69-10013

THE INTERREGIONAL DYNAMIC INPUT-OUTPUT PROGRAMMING MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.

Jona Bargar.

Econ Evaluation Water Part VI, Chap 5, Water Resources Center Contrib No 128, Calif Univ, Berkeley, p 37-53, June 1969. 17 p, 3 tab.

Descriptors: *Input-output analysis, *Dynamic programming, *Linear programming, *Regional analysis, *Resource allocation, Water management (Applied), Trade associations, Capital, Investment, Optimization.

Identifiers: Shadow prices.

In order to treat capital investment aspects as well as production aspects in an interrelated economy of two regions (California and other Western States) considering the optimum allocation of available water resources, various input-output models, linear programming models and dynamic input-output programming models were incorporated into one complete programming model. The formulation of an interregional dynamic input-output programming model with special attention to water resources management required the introduction of the dynamic aspect into each regional model of the two regions, and then the linking together by their trade balance. Once the complete model was formulated, its special features and usefulness were discussed and tested with actual data to evaluate the empirical results. Solutions to both the primal and dual linear programming maximizing problems were presented. The importance of shadow prices as expressions of the real value imputed to water under the assumptions of the model in an optimal solution was also discussed. (Thiuri-Cornell)

W69-10015

ECONOMIC EVALUATION OF WATER PART VI: A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY,
California Univ., Berkeley. Sanitary Engineering Research Lab.For primary bibliographic entry see Field 06A.
W69-10016**ECONOMIC EVALUATION OF WATER: PART 6, A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY,**
California Univ., Berkeley. Sanitary Engineering Research Lab.

Jona Bargar.

Calif Univ Water Resources Center Contrib No 128, June 1969. 125 p, 1 fig, 24 tab, 110 ref, 4 append. OWRR Proj No B-017-CAL, WRC Proj No W112.

Descriptors: *Water resources development, *Economics, *Optimization, *Input-output analysis, *Mathematical models, Water management (Applied), Decision making, Dynamic programming, California, Arid lands, Social aspects, Costs, Cost-benefit analysis.

Identifiers: *Water resources economics.

A mathematical model is used to analyze the economic value of water in California and the other semiarid western States. Dynamic programming and input-output analysis are used to optimize water uses and costs, assuming that maximum economic growth is an accepted goal of society. The constraints of the model include capital and labor costs as well as water availability. (Knapp-USGS)

W69-10087

SEMPOR PROJECT-GENERAL PLAN,
Ministry of Public Works and Power, Djakarta (Indonesia). Water Resources Development.
For primary bibliographic entry see Field 08A.
W69-10100**A STUDY OF THE FEASIBILITY OF SOCIAL SCIENCE RESEARCH DESIGNED TO IDENTIFY AND ANALYZE SOCIAL RESPONSES TO PRECIPITATION MANAGEMENT OPERATIONS IN NEW ENGLAND,**
New Hampshire Univ., Durham. Dept. of Political Science.

Roger S. Hoeh.

Report, Department of Political Science, University of New Hampshire, Oct 1968. 55 p, 2 append, 14 ref. Bureau of Reclamation, Order Number 8-D-3944, Amendment No 1.

Descriptors: Social aspects, Resources.

Identifiers: *New England, *Precipitation management.

This paper examines precipitation management in New England and possible directions of research on the social implications of precipitation management. Information used in the study was obtained from a sampling of the available literature related to precipitation management and interviews with people concerned with water resources. The study covers three areas. First, the state of the art or what precipitation management involves is examined. Second, New England's need for precipitation management and its experience with such operations are discussed. Finally, the directions that social science research may follow in assessing the social impact of precipitation management in New England is presented. A chapter on a recommended program of research is included. (Grossman-Rutgers)

W69-10192

MEETING STATE RESPONSIBILITY IN WATER RESOURCES DEVELOPMENT,
Colorado Univ., Boulder.

Calvin T. Watts.

IN Water: Development, Utilization, Construction, 5th Western Resources Conference, Boulder, Colo, p 127-134, 1963.

Descriptors: *Water resource development, *Louisiana, Budgeting, State jurisdiction, Administrative agencies, Planning.

Identifiers: Louisiana, *Dept. of Public Works.

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

Louisiana is a water-rich state; their problem is the management of that water because of threats of flooding, beach and shore erosion, salt-water intrusion, and uneven distribution of water with respect to time and place. In Louisiana, the Department of Public Works is the agency responsible for management at the state level. Its duties include planning, promoting, engineering and implementing the construction of all water projects affecting the general welfare of the state. It maintains a close relationship with local governmental units and water districts and works closely with Louisiana's Congressional delegation and with the state legislature. In addition, they also have many cooperative programs with federal agencies. The consequences of this type of public policy is reflected in the fact that Louisiana is one of four states who have made significant progress in water resources development and whose budget for water resources is around \$10,000,000 annually. (Starr-Chicago)

W69-10194

TRENDS IN METROPOLITAN WATER DEVELOPMENT,

Colorado Univ., Boulder.

Don Hummel.

IN Water: Development, Utilization, Construction, 5th Western Resources Conference, p 115-124, 1963.

Descriptors: *Water resources development, *Water pollution control, Sewage treatment, Watershed management, Drainage basin, Interagency commission on water resources, State jurisdiction, Federal aid.

Identifiers: *Advisory Commission on Intergovernmental Relations, *Metropolitan comprehensive planning.

A report of the vice-chairman of the Advisory Commission on Intergovernmental Relations in which recommendations for state and federal action in metropolitan water resources development are made. The basic difficulties of inadequate investment in water and sewage facilities and the fragmented political responsibility in urban areas point to the need for more of a metropolitan approach to the planning and development of metropolitan water facilities. Five recommendations to the states are made: (1) Provide grants for sewage treatment plant construction to supplement federal aid; (2) provide incentives for comprehensive development on a watershed, drainage basin or metropolitan area bases; (3) expand state technical assistance programs; (4) liberalize debt limits and referenda requirements; and (5) permit joint action by units of local government in meeting their water and sewage needs. The recommendation to the federal government is that the grants made under the Water Pollution Control Act could be used as a more effective tool for metropolitan water planning if incentives were provided for more economical and comprehensive plans. (Starr-Chicago)

W69-10195

MUNICIPAL WATER IN FEDERAL PROGRAMS,

Colorado Univ., Boulder.

Henry P. Caulfield, Jr.

IN Water: Development, Utilization, Construction, 5th Western Resources Conference, Boulder, p 101-113, 1963.

Descriptors: Water supply, Local governments, Water quality, Federal jurisdiction, State jurisdiction, Social values, Political aspects.

Identifiers: Agricultural use vs. municipal use, State roles, Alternative uses of water.

An analysis of municipal water in federal programs is divided into two parts: (1) federal programs concerned with municipal and industrial water supply in relation to non-federal programs and the responsibilities of state and local government and of private enterprises; and (2) municipal and industrial water supply within the totality of federal policy, planning and action for use and development of

water and related land resources. The basic role of the federal government is seen as a supportive one; with primary responsibility resting with municipalities. The state role, until recently, has been concerned with public health, determination of water rights, resolving interstate conflicts, and providing basic data of a geologic nature. Conflicts between alternative uses are pointed out, and the failure to adequately face consequences of each alternative is shown to be the one shortcoming of water planning. Agricultural use versus municipal use is viewed as merely involving the transfer of existing water rights from agricultural to municipal and industrial use. However, the subjective values which influence political decisions will play as important a role as the economic-objective values. (Starr-Chicago)

W69-10196

WATER POLICY THEMES AND PROBLEMS FOR THE 1960's AND 1970's SUMMARY AND CONTENT,

Colorado Univ., Boulder.

Michael F. Brewer.

IN Water: Development, Utilization, Construction, 5th Western Resources Conference, Boulder, Colo., 1963. p 225-231.

Descriptors: *Water resource development, *Research and development, Economics, Comprehensive planning, Water supply, Water demand, Administrative agencies.

Identifiers: Inter-disciplinary research.

A Summary of the 1963 Western Resources Conference; two phenomena relevant to present water policy are described: (1) a shift in the relative demands on water resources; and (2) an increased understanding of the close relationship between water and other natural resources. The shifts in relative demands under water-scarce conditions will not be solved by merely developing additional supplies, but, will necessitate curtailment in use elsewhere—or rationing of water to allow for equitable allocations among competing demands. The interdependency between water and other resources has increased the economic necessity for mutually consistent and comprehensive resource development and management policies. Arrangements need to be found for improving and extending common standards and criteria presently used by federal agencies. This will require a periodic process of review--not an agency-by-agency basis but by an interagency body to a professional and objective group. Rationale for allocation of research funds needs to be developed and existing rationale improved. There are too many dangers in rushing in at the federal level to fill a research gap. The contribution that economics can make is to provide a way of systematically assessing alternative ways of managing water resources in order to arrive at rational policy decisions. But the economist can neither define future problems nor develop alternative solutions without the help of the engineering, the social and the physical sciences—an inter-disciplinary approach is necessary and complementary. Efforts of many universities reflect their cognizance of the necessity of this approach. (Starr-Chicago)

W69-10200

ADVOCACY AND RESOURCE ALLOCATION DECISIONS IN THE PUBLIC SECTOR,

Bowdoin Coll., Brunswick, Maine.

A. Myrick Freeman, III.

Natural Resources Journal, Vol 9, p 166-175, April 1969.

Descriptors: *Decision making, *Resource allocation, Motivation, Social junction, Social aspects, Public benefits, Costs, Organizations, Conservation, Taxation.

Identifiers: *Advocacy, Sierra Club, Tax deductions.

A particular structure for making decisions in the public sector is considered and its implications for

achieving an optimum resource allocation is discussed. Many decisions in the public sector are the result of a process of advocacy in which two interested parties or groups attempt to persuade or influence a decision maker to take or not to take a certain course of action. The role of the Sierra Club in the Grand Canyon Dam controversy and their subsequent loss of tax deductible status is a case in point. The process of advocacy is reduced to its essential elements and described by a model. An analysis of the behavior of the advocacy model considers two separate problems, the level of activity or advocacy cost which a group will choose, and the influence of advocacy on the decision. The larger the group the less chance there is of its organizing for collective action and maximizing benefit. The advocacy process is evaluated for efficiency as a way of making decision and as a process that makes the 'right' decisions. In conclusion, if advocacy is to be used as a decision-making process, the quality of decisions which result might be improved by policies designed to overcome the inherent disadvantages of large groups in the advocacy process, e.g., a subsidy. Costs of a subsidy shared by all taxpayers would be weighed against the benefits of better decisions, which would also be more widely distributed. (Marriott-Chicago)

W69-10203

A FRAMEWORK FOR DEALING WITH THE URBAN ENVIRONMENT: INTRODUCTORY STATEMENT,

Resources for the Future, Inc., Washington, D.C.

Harvey S. Perloff.

IN The Quality of Urban Environment: Essays on 'New Resources' in an Urban Age, Resources for the Future, Inc., Johns Hopkins Press, Baltimore, p 3-31, 1969. 2 tab, 1 append, 12 ref.

Descriptors: *Decision-Making, *Resources, Environment, Planning, Systems analysis.

Identifiers: *Urban environment, *Policy making, Social accounts, Social indicators.

Conceptual and measurement issues of the urban environment are the focal point of this study. Stressing aspects of policy-making and public action, it is pointed out that concepts which act to simplify and unify the complexities of the urban environment contribute to the development of a common ground of understanding. Two such concepts are suggested: an extension of the concept of resources, and the urban environment as a subsystem. The first concept suggests the need to consider non-commodity resources as well as the traditional commodity resources in the general concept of resources. The second concept stresses the view that the urban environment is a contained (but not closed), highly interrelated system or subsystem of natural and man-made elements in various mixes. Also discussed are policy measures and an analytic decision framework. This system consists in part of a set of different specific environments to be considered. Included are: the natural environment, the spatial environment, the transportation-utilities environment, the community-or-neighborhood environment, and microenvironments. These various environments can then be evaluated on the basis of various social indicators and accounts. These include indicators of present condition, costs of environmental maintenance at present levels, costs of environmental abuses and shortfalls, costs of achieving standards at various levels, and benefits of achieving standards at various levels. (Davis-Chicago)

W69-10206

THE ECONOMICS OF WATER TRANSFER,

California Univ., Berkeley. Giannini Foundation.

Michael F. Brewer.

Natural Resources Journal, Vol 4, No 3, p 522-536, Jan 1965. 10 ref.

Descriptors: *Water transfer, *Economic impact, Economic efficiency, Economic life, Equitable apportionment, California, Water distribution (Applied), Investment.

Cost Allocation, Cost Sharing, Pricing/Repayment—Group 6C

Identifiers: Water mobility, Value of public goods, Tenure forms, Payment forms, Self-adjusting economy.

The article discusses the way in which water transfer arrangements affect economic growth. Section I analyzes the economic significance of water transfer. When economic growth is interpreted dynamically, the transfer not only allocates water, but also maintains a given rate of investment by agencies within the marketing spectrum. Section II discusses the functional relationship between water transfer and economic growth. The section focuses on: the relationship between water mobility and economic growth; quantitative problems involved in transfer between public and private agencies; the efficient transfer process, which is reflected by a high rate of growth and by the duration of that rate; and problems of equity. Section III assesses tenure forms and payment forms. Section IV traces the history of changing water institutions in California. There are five stages: (1) irrigation with local water; (2) development of more distant regional sources; (3) integrated management of ground and surface water; (4) coordination of jurisdiction among water supply agencies; and (5) provision for increasing urban demand. These mutations have permitted more efficient allocation as new problems become apparent, and they increase the probability that economic growth will be self-adjusting. (Gossen-Chicago)

W69-10208

THE INTERSTATE COMPACT—A FORM OF CREATIVE FEDERALISM,

Frederick L. Zimmermann.

Journal of Soil and Water Conservation, Vol 24, No 3, p 95-97, May-June 1969. 3 p.

Descriptors: *Interstate compacts, *Interstate commissions, *Water resources development, *Intergovernmental cooperation, River basin commissions, Governments, Political aspects, State governments, Federal government, Interstate, River basin development, Legislation, Water law, Institutions, Regions, Basins.

Identifiers: Inter-level coordination.

As authorized by article 1, section 10 of the Constitution, interstate compacts have been used for a wide variety of purposes to meet growing intergovernmental problems in our federal system. The compact's uniqueness as a contract between or among enacting states makes it superior to uniform laws since no state may subsequently amend or withdraw except in accordance with its terms. These terms are enforceable in both state and federal courts. In addition to acceptance of the uniform document, states must also enact enabling statutes that aid effectuation of the agreement. The Constitution requires Congressional consent, but this may be obtained by implication with little opposition. The contractual nature of the interstate compact makes it the best legal instrument that can establish a joint agency of several jurisdictions which is also a joint agency of each of them. It is also used for interlevel coordination with state, local, and federal governments. Many operate without formal agencies; others are merely facilitative. The Delaware River Basin Compact is an excellent example of a truly inter-governmental agency, and it shows that despite federal reservations, this is a promising road to creative federalism. (Doublerley-Fla)

W69-10214

WATER RECREATION - PUBLIC USE OF 'PRIVATE' WATERS,

Joseph B. Gaudet.

Calif L Rev, Vol 52, No 1, p 171-184, Mar 1964. 14 p, 110 ref.

Descriptors: *Recreation, *Riparian rights, *Water utilization, *Public benefits, Legal aspects, Land tenure, Recreation facilities, Riparian land, Bodies of water, Legislation, Flood control, Navigable

waters, Non-navigable waters, Federal government, State governments, Judicial decisions, Relative rights.

Water recreation in America is rapidly increasing in popularity. The pressure of this increasing nationwide demand for water recreation coupled with the limited availability of adequate facilities will increasingly create conflicts between the public and riparians when, for example: (1) the state wishes to condemn a public access way to a body of water across privately owned riparian land; or (2) the public, already having access, wishes to use the body of water and the riparians object. Conflicts may arise among riparians if, for example: (1) one of several riparians, all of whom claim a right to use all or part of a body of water, wishes to exclude the others; or (2) a riparian resort owner admits members of the public to use the entire body of water and other riparians object. This comment explores the problems arising from these conflicts and evaluates attempted solutions in light of policy considerations and legal doctrine. There should be serious legislative consideration of to what extent the public need for water recreation should be satisfied through access way condemnation, improvement of existing bodies of water, inclusion of recreation facilities in flood control projects, and other similar methods. (Heckerling-Fla)

W69-10215

TRENDS IN WATER RIGHTS LEGISLATION.

Am Water Works Ass'n J, Vol 50, No 10, p 1267-1278, Oct 1958. 12 p.

Descriptors: *Water rights, *State governments, *Legislation, *Water resources, Water resources development, Surface waters, Groundwater, Water conservation, Research and development, Water policy, Legal aspects, Water supply, Water allocation (Policy), Water requirements, Adoption of practices, Administration.

One general trend in state water rights legislation as of 1958, is toward more state regulation of natural water resources. An examination of advances in water rights laws reveals that a number of eastern state legislatures are planning for, and engaging in, increased water conservation programs. Each state is treated separately, and its action or inaction in the area of water rights law is reported. Further, groups of states (such as the eastern central states, the Atlantic coast states, and the north central states) are dealt with as units; each unit is discussed by a different author. (Kelly-Fla)

W69-10217

WATER RIGHTS POLICIES IN THE SOUTHEAST,

C. P. Guess, Jr.

Am Water Works Assn J Vol 47, No 9, p 840-844, Sept 1955. 5 p.

Descriptors: *Southeast US, *Water management (Applied), *Water rights, *Water policy, Legislation, Federal government, Regulation, Water consumption, Control, Water users, Industries, Cities, Water demand, Industrial use (Water), Agriculture, Irrigation water, Water allocation (Policy), Water distribution (Applied).

There has been a pronounced acceleration in water management programs in recent years, particularly in the Piedmont and coastal areas of the Southeast United States. This is a result of a greatly increased consumption of water for irrigation, livestock raising, industries, and municipalities. Recent conflict among water users has been brought about by: (1) industrial expansion and development; (2) an increase in daily per capita requirements; (3) population increases; (4) population shifts; and (5) greater use in agriculture resulting from experience and research. Many states have already exerted the right to control and assign water. The federal government has recently passed legislation attempting to remedy these problems. The Southeast is well supplied with water at present; however,

definite rules must be established in the field of water management for future growth. (Heckerling-Fla)

W69-10220

WATER RIGHTS AND ADMINISTRATION WITH RESPECT TO SOIL AND WATER CONSERVATION,

For primary bibliographic entry see Field 06E.

W69-10221

GREAT LAKES RIVER BASINS COMMISSION.

Ind Ann Stat secs 68-1401 thru 68-1404 (Supp 1968).

Descriptors: *Indiana, *Great Lakes, *Administrative agencies, *Great Lakes Region, St. Lawrence River, Water resources, Water resources development, Planning, Projects, Resources, Leadership, Coordination, Priorities, Construction, Legislation, Governments, Federal government, State governments.

The membership of Indiana in the Great Lakes River Basins Commission, established by the executive order of the President of the United States, is hereby ratified. The functions and duties of said Commission are to: (1) serve as the principal agency for coordination of federal, state, local, and non-governmental plans for the development of water and related land resources within those portions of the eight Great Lakes states drained by the St. Lawrence River system; (2) prepare and keep up to date a comprehensive, coordinated, joint plan for such development; (3) recommend long-range priorities for the collection and analysis of data for investigation, planning, and construction of projects; and (4) undertake necessary studies of water and related land resources problems. The Indiana member of the Commission is appointed by and serves at the pleasure of the governor. The Department of Natural Resources provides administrative, technical, and advisory services to the Commission. (Marsee-Florida)

W69-10247

SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE,

Texas Water Development Board, Austin.

For primary bibliographic entry see Field 06A.

W69-10292

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

RESOURCE ALLOCATION WITH PROBABILISTIC INDIVIDUAL PREFERENCES,

Harvard Univ., Cambridge, Mass.

Richard Zeckhauser.

American Economic Review Vol LIX, No 2, p 546-552, May 1969. 7 p, 2 ref.

Descriptors: *Risks, *Compensation, *Prediction, Demand, Preferences, Utilities, Income.

Identifiers: *Option value, *Actuarial model, *Collective consumption, *PIP, Risk sharing, Community insurance decision, Correlation, Nonvoluntary contribution.

This article is concerned with the allocation of PIP goods (goods to which some probability assessment has been attached for possible sets of individual preferences). Efficient provision of these goods demands they yield sufficient returns to enable discounted revenues to cover discounted expected costs, and that they provide a suitable amount of risk-spreading. In addition, allocation of PIP goods should involve the concepts of both utilities of anticipation and utilities of use. (Although there is only a slight chance of benefiting from consumption of a PIP good, for instance, the benefit may be sufficient to make the premium worthwhile.) Finally, it is generally best to provide PIP goods on a collective basis for efficiency of storage, for

Field 06—WATER RESOURCES PLANNING

Group 6C—Cost Allocation, Cost Sharing, Pricing/Repayment

aspects of collective consumption, and for cost-sharing provision. The essential character of PIP goods makes this article of interest to water researchers. (Murphy-Rutgers)
W69-09956

PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION,
Virginia Polytechnic Inst., Blacksburg, Va.
Gordon Tullock.
American Economic Review Vol LIX, No 2, p 189-197, May 1969. 9 p, 3 fig, 1 ref.

Descriptors: *Market economies, *Welfare economics, *Government, *Optimization, Mosquitoes, Consumption, Cost, Compensation, Income.

Identifiers: *Externalities, *Collective provision, *Individual provision, *Paretian criterion, *Geographical contiguity, Single-peaked preferences.

This article presents a discussion of social cost by utilizing a technological discussion of mosquito abatement, for the reason that such a discussion reveals almost all decision problems which could be involved in reaching a solution for the problem. Government is involved, first of all, due to the large costs. These costs encourage voters to opt for collective provision for the problem in lieu of individual provision, even though a less than optimal arrangement of resources may result by their own preference ordering. Further, this collectivization process is preferred under small-size government units, since as the size of such units increases, the number of externalities internalized increases, and the adjustment of government activity decreases proportionately. Optimally when the quantity of public good consumed is determined by the voting process, as few individuals as possible should have need of compensation for losses suffered by the collectivization process. Finally, the area of public goods involves another problem for the governmental action in geographical contiguity, which often involves economies of scale. Since the water resource planner encounters the problems of public goods quite often, this article should prove useful. (Murphy-Rutgers)
W69-09958

A PUBLIC CHOICE APPROACH TO PUBLIC UTILITY PRICING,
California Univ., Los Angeles.
James M. Buchanan.
Public Choice, Vol V, p 1-18, Fall 1968. 19 p, 5 fig, 3 ref.

Descriptors: *Pricing, *Government, *Costs, Investment, *Economic analysis, Political aspects, Average prices, Average cost, Marginal cost, Optimization, Supply, Equilibrium, Costs, Model studies, Taxes.
Identifiers: *Decreasing-costs, *Pareto optimality, *Public utility pricing.

The traditional problem of pricing and investment for decreasing-cost enterprises is examined in a model based on the assumption that individuals make collective as well as private consumption decisions. In a fully closed behavioral model, the analysis shows that when the necessary equality between marginal cost, marginal price, and marginal evaluation is satisfied, average price must equal average cost. The policy conflict between average-cost and marginal-cost pricing for increasing returns facilities does not exist. The analysis forms a defense of the multi-part tariff or club principle of pricing in decreasing-cost facilities. For Pareto optimality, marginal price need not equal average price and this equality cannot be realized when average costs fall throughout the relevant output range. Decreasing cost phenomena are a standard characteristic of many water resource investment projects and this treatment of the cost problem should be of interest to the water researcher. (Murphy-Rutgers)
W69-09962

COMMENT ON ECONOMY OF WATER QUALITY MANAGEMENT AND POLLUTION CONTROL,
Vulcan Materials Co., Birmingham, Ala.
For primary bibliographic entry see Field 05G.
W69-09965

ON THE PURE THEORY OF PUBLIC GOODS,
Rome Univ. (Italy). Instituto di Economia e Finanza.
G. Campa.
Public Finance Vol XXII, No 4, p 401-416, Spring 1967. 6 fig, 16 p.

Descriptors: *Optimization, *Welfare economics, *Resource allocation, Economic analysis, Costs, Value, Equilibrium, Cost sharing, Model studies, Pricing.

Identifiers: *Public goods, Indivisible goods, *Pareto optimality, Duopoly.

This article attempts to give a generalized theoretical framework to the voluntary solutions of the determination of public goods. It also seeks to indicate additional complications inherent in any attempt by a decentralized system to reach a Pareto-optimum when an indivisible good is involved. Further discussion concerns the contrasting results reached by the Lindahl-Johansen analysis and the Musgrave-Samuelson analysis. The theoretical discussion of the general case of public goods would be applicable to many water development projects which exhibit indivisible production constraints. (Murphy-Rutgers)
W69-09966

COLLECTIVE-CONSUMPTION SERVICES OF INDIVIDUAL-CONSUMPTION GOODS,
Wisconsin Univ., Madison.
Burton A. Weisbrod.
Quarterly Journal of Economics, Vol LXXVIII, No 3, p 471-477, August, 1964. 7 p.

Descriptors: *Demand, *Government supports, Marginal cost, Taxes, Government, Value, Recreation, Profit, Economic analysis, Economic efficiency, Prices, Industrial production, Welfare economics.

Identifiers: *Option-demand, *Collective-good.

A number of significant commodities exist which are apparently of a pure individual-consumption variety, but which also possess characteristics of a pure collective-consumption good. The author, after demonstrating the truth of this observation, discusses some of the implications. In particular, it is pointed out that even if some apparently individual-consumption goods cannot be profitably provided by private enterprise, it may serve the social welfare to subsidize their production. The collective-good aspect of the commodity is pointed out to be the existence of option demand. The option demand can be satisfied at zero marginal cost when the actual uses of the commodity provide a profit. However, this option demand becomes critical at the margin. The option demand by potential users is particularly relevant to the area of water resources, with recreation and the national park system cited in the article as examples of the existence of option demand. (Murphy-Rutgers)
W69-09974

DISCRETE DYNAMIC PROGRAMMING AND CAPITAL ALLOCATION,
Johns Hopkins Univ., Baltimore, Md.; and Stanford Research Inst., Menlo Park, Calif.
G. L. Nemhauser, and Z. Ullmann.
Manage Sci, Vol 15, No 9, p 494-505, May 1969. 12 p, 1 fig, 3 tab, 19 ref.

Descriptors: *Dynamic programming, *Capital, *Resource allocation, *Optimization, *Return (Monetary), Investment, Constraints, Variability.
Identifiers: Borrowing, Lending.

Dynamic programming algorithms were developed for optimal capital allocation subject to budget

constraints. The work included multilevel projects, reinvesting returns, borrowing and lending, capital deferrals, and project interactions. Due to the monotone non-decreasing step function nature of optimal returns it was possible to handle dynamic programming models with several state variables. Computational experience with a variety of problems was reported. (Thiuri-Cornell)
W69-10017

WATER RIGHTS LAW IN IOWA,

M. K. Tenny.
Am Water Works Assn J, Vol 51, No 3, p 329-332, Mar 1959. 4 p.

Descriptors: *Iowa, *Water rights, *Legislation, *Water allocation (Policy), Adjudication procedure, Administrative agencies, Natural flow doctrine, Riparian rights, State governments, Legal aspects, Water law, Water utilization, Beneficial use, Permits, Riparian land.
Identifiers: Water commissioner.

The Code of Iowa, as amended by the Iowa legislature in 1957, provided for an office of water commissioner to be chosen by the state's Natural Resources Council. The commissioner's duty is to process all applications for water appropriation permits. The present policy (October 1958) seems to be to approve all requests for water for what he and his deputies decide are beneficial uses of water. If an application is opposed, the burden of proof is placed by the commissioner on the opposition. Under the riparian doctrine, which was the law in Iowa previous to this amendment, a person owning riparian property was entitled to the use of the water flowing by in its natural current or channel, undiminished in quantity and unimpaired in quality. The new statute makes it the duty of the water commissioner to serve in a quasi-judicial capacity as the trier of fact questions in the processing of all applications for appropriation permits. (Heckerling-Fla)
W69-10216

6D. Water Demand

WATER REUSE: A TEXAS NECESSITY,
Texas Water Quality Board, Austin.
For primary bibliographic entry see Field 05D.
W69-09882

ARKANSAS WATER RESOURCES: SUPPLY, USE, AND RESEARCH NEEDS,
Arkansas Univ., Fayetteville. Dept. of Economics.
Jared Sparks.
Arkansas Univ Water Resources Res Center Pub No 2, 1967. 100 p, 15 fig, 10 tab.

Descriptors: *Water resources development, *Arkansas, Research and development, Water supply, Water utilization, Water management (Applied), Floods, Flood control, Surface waters, Groundwater, Hydrologic data, Data collections, Limnology, Water pollution, Water pollution control, Reservoirs, Industrial water, Municipal water.
Identifiers: Water resources research.

Arkansas' water resources research needs are discussed against an economic backdrop of water supply and use conditions existing in the state. In the aggregate Arkansas has an abundance of high quality water relative to present use. There are local conditions that give rise to water problems, but, in general, critical water problems in Arkansas are emergent and potential rather than actual. The causes of these problems are to be found, in large part, in the economic, legal, and social institutions surrounding water use—and particularly in the economic institutions. Research designed to improve economic efficiency criteria and to develop methods of applying such criteria to water resources planning, to water resources allocation, and to quality of water control would do much to mitigate the problems of water management in the future. Research of this nature requires con-

siderably more water data concerning supply, use, and costs associated with water use than are now available. Other promising areas of research include basic research on the nature of water and the water cycle, and applied research in areas of flood control, artificial recharge, the measurement of pollution damage and costs, the identification and treatment of pollution, the limnology of artificial lakes, and the role of water resources in industry location. (Knapp-USGS)
W69-09940

WATER USE IN THE PETROLEUM AND NATURAL GAS INDUSTRIES,
Bureau of Mines, Washington, D.C. Div. of Statistics.
Paul M. Buttermore.
Bur Mines Inform Circ No 8284, 1966. 36 p, 9 fig, 16 tab, 10 ref, append.

Descriptors: *Water utilization, *Oil industry, Drilling, Natural gas, Injection, Water reuse, Reclaimed water, Secondary recovery (Oil), Data collections.
Identifiers: Oil industry water use, Oil refining.

As part of a national canvass of water use the Bureau of Mines compiled data on water requirements in the petroleum and natural gas industries for the calendar year 1962, specifically in well drilling, secondary-recovery operations, and natural gas processing plants. Total new water use in the petroleum industry of the United States, excluding refining, was 5.3 billion barrels. Secondary-recovery operations and natural gas processing plants required about 2.5 billion barrels of new water input; each of these requirements was about eight times greater than that for well drilling. Total use, including recirculated water, was 45.3 billion barrels of which 3.4 billion barrels was consumed. The greatest use of recirculated water was for natural gas processing, amounting to 38.2 billion barrels. Projections of total water use show that by 1975, 75.4 billion barrels will be used by the petroleum industry, of which 10.2 billion barrels will be new water. By 1985, the total use requirement will be 92.8 billion barrels, of which 13.1 billion barrels will be new water. (Knapp-USGS)
W69-09944

FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER,
Forest Service (USDA), Washington, D.C. Div. of Watershed, Recreation, and Range Research.
For primary bibliographic entry see Field 03B.
W69-10004

ECONOMIC ASPECTS OF PRIVATELY OWNED FISHING ENTERPRISES IN WISCONSIN,
Economic Research Service, Washington, D. C. Natural Resource Economics Div.
Rudolph A. Christiansen, Sydney D. Staniforth, Aaron Johnson, Jr., and Rollin B. Cooper.
Research Report 46, Research Division, College of Agricultural and Life Sciences, University of Wisconsin, June 1969. 13 p, 1 fig, 17 tab.

Descriptors: *Boating, *Sport fishing, *Financial analyses.
Identifiers: Wisconsin, Ownership of recreational facilities, Economic survey.

In 1966 Wisconsin contained 5,734 privately owned outdoor recreation enterprises. Of these, 1,516 offered fishing facilities. Fishing was a major activity at 34% of these enterprises. The most common form of ownership was individual. The fishing enterprises were seasonal, part-time enterprises. Data on the amount of income and the distribution of capital among different sized enterprises is included. Factors important in running successful enterprises are: getting along with the public and knowing the business. The best form of advertisement are satisfied customers. Some problems of operation are discussed. (Grossman-Rutgers)
W69-10191

WASTE WATER RECLAMATION, LOS ANGELES COUNTY,
Colorado Univ., Boulder.
For primary bibliographic entry see Field 05D.
W69-10197

RESEARCH AND DEVELOPMENT FOR REUSE OF WATER,
Colorado Univ., Boulder.
For primary bibliographic entry see Field 05D.
W69-10198

WATER RESOURCES RESEARCH,
Colorado Univ., Boulder.
E. D. Eaton.
IN Water: Development, Utilization, Construction, 5th Western Resources Conference, Boulder, Colo., 1963. p 201-213.

Descriptors: *Research and development, Public benefits, Water supply, Water demand, Federal budgets, Federal project policy.

Since requirements for water are rapidly growing while the amount of available water is fixed, research is seen as the means of enlarging the amount of available water for use. A report of a task group established by the Office of Science and Technology identified five areas which require research by the federal government: (1) planning for development and use of controllable supplies; (2) increasing supplies for beneficial uses; (3) improving the efficiency of use; (4) maintaining and improving water quality; and (5) preventing water-caused damage. An examination of federal research programs in water for the fiscal year 1964 led to the conclusion that greater emphasis should be given to intramural and extramural education and training, to research on water quality, and to socio-economic research. The difficulty of assessing projects which will yield the greatest benefits is pointed out, as well as the need for coordination in water resources research, the need for qualified research personnel, and the inter-relationship between research and public policy and decision-making. (Starr-Chicago)
W69-10201

IMPACTS OF RECREATION ON COMPETITION FOR USE OF WATER,
Colorado Univ., Boulder.
Walter S. Hopkins, Jr.
IN Water: Development, Utilization, Construction, 5th Western Resources Conference, Boulder, Colo., 1963. p 151-161.

Descriptors: *Outdoor recreation, Swimming, Boating, Access routes, Economic impact, Multiple-Purpose projects, Reasonable use, Water quality, Reservoir operation, Competing uses.

With the present trend for water-based recreation expected to continue, the article estimates that by the year 2000 swimming will be the most popular single outdoor recreation activity. A number of economic studies have attempted to place a monetary value upon the intangible of a recreation experience; a more productive approach has been to measure the impact of recreation on the economy of an area. The impact of recreation on municipal water supply has been considered resulting in two widely held conclusions: (1) swimmers and other recreationists do not create any pollution problem that can't be handled by existing water treatment facilities; and (2) it is unfair for all taxpayers to pay the cost of filtration plants in order to take care of the recreational needs of a few. The greatest impact of recreation has been its influence upon multi-purpose water impoundment. Management of impoundments built for a single purpose yields reservoirs which are less than ideal for recreational purposes. The problem of access to these man-made impoundments is also serious one; acquisition of private lands well above the high-water mark will help alleviate this problem. The major recommendation of the article: the concept of comprehensive planning for water resource

development throughout the nation to be enlarged to include all purposes served by water resources. (Starr-Chicago)
W69-10202

RESEARCH ON NATURAL RESOURCES: A REVIEW AND COMMENTARY,
Conservation Foundation, Washington, D.C.
Samuel H. Ordway, Jr., Wallace D. Bowman, and John Milton.
Natural Resources Journal, Vol 4, No 1, p 42-66, May 1964. 17 ref.

Descriptors: *Water demand, Methodology, Conservation, Systems analysis, Optimization, Ecological distribution, *Water resources development, Mineralogy, Energy, Social aspects, Economics.
Identifiers: *Research needs, *NAS-NRC Committee on Natural Resources, *Federal Council for Science and Technology, Renewable resources, Marine resources.

The article summarizes and evaluates the findings of the NAS-NRC Committee on Natural Resources and of the Federal Council for Science and Technology. It supports the major recommendation, gleaned from both reports, for more integrated research on the environment. Section I discussed the NAS-NRC summary report and its six supporting studies on: renewable resources; water resources; mineral resources; energy resources; marine resources; and social and economic aspects of natural resources. The summary report emphasizes the need for understanding the interplay between the social and natural sciences to meet requirements of productivity 'without lasting damage to our natural endowment.' The reports on water and marine resources explicate research priorities in water management. The report on social and economic aspects compares established policies with a view of the world as a complex set of systems, which must be continually analyzed for the optimum use of each factor. Section II contrasts the Federal Council's report with the NAS-NRC report. The Council's approach is primarily economic and technological; its concern is increasing the gross national product. The NAS-NRC approach is primarily ecological; its concern is sustaining the resource base and a total environment. (Gossen-Chicago)
W69-10210

DETERMINING WATER REQUIREMENTS FOR SETTLING WATER DISPUTES,
Harry F. Blaney, and Wayne D. Cridle.
Natural Resources Journal, Vol 4, No 1, p 29-41, May 1964. 3 tab, 19 ref.

Descriptors: *Consumptive use, Water distribution (Applied), Water utilization, Water requirements, Irrigation water, Negotiations, Judicial decisions, Legislation.

Identifiers: *Blaney-Cridle formula.

Before the equitable division of waters of a drainage basin can be made, careful consideration must be given to the consumptive-use requirements for water in each sub-basin. Consumptive use of water (evapotranspiration) and resultant stream depletions are of utmost importance to water users sharing limited supplies. Section I describes the Blaney-Cridle formula to determine consumptive use by vegetation. Section II documents use of the B-C formula in specific areas, including: water requirements for irrigated areas; compact negotiations; adjudications; litigation; and international negotiations. An example of computations of water use in Arizona, New Mexico, Utah, California, and other western states is given. Compact negotiations between the states in the Upper Rio Grande, Pecos River, and Colorado River basins employed B-C calculations. Some state engineers have based diversion allocations of agricultural water on B-C computations. The formula has been called upon in litigation of water rights in states of the lower Colorado River basin. Although political agreement on Jordan River waters has not been reached.

Field 06—WATER RESOURCES PLANNING

Group 6D—Water Demand

it is felt that technical agreement was reached through the B-C approach. The B-C method has greatly facilitated treaty negotiations between Pakistan and India. (Gossen-Chicago)
W69-10211

6E. Water Law and Institutions

POWER TO ACQUIRE AND DISPOSE OF PROPERTY; RESTRICTIONS AS TO DISPOSITION OF WATER FRONT.

Ky Rev Stat Ann sec 87.080 (1963).

Descriptors: *Kentucky, *Cities, *Leases, *Shores, Legislation, Transportation, Land tenure, United States, Rivers, Facilities, Administrative agencies, Piers, Local governments.
Identifiers: *Water front.

The city council may not dispose of any water front property, except when required by the United States Government for the improvement of rivers and facilities for water transportation along the water front. The city council may lease the water front for a term not exceeding twenty years. However, wharf privileges shall not be leased for more than five years. (Heckerling-Fla)
W69-09889

LANDS IN OHIO RIVER BED.

Ky Rev Stat Ann sec 56.220 (1963).

Descriptors: *Kentucky, *Ohio River, *Beds, *Leases, Legislation, Accretion (Legal aspects), Streams, Islands, Judicial decisions, Land use, Contracts, Sands, Gravels, Ownership of beds.

All that portion of the bed of the Ohio River lying north of the thread of the stream, except accretions to islands privately owned, is declared to be vacant and unappropriated land, and the county court of each county bordering on the Ohio River may use or lease the river bed for county purposes upon such terms and conditions as seem beneficial to the county. Any contract of leasing made by any such county court of such river bed for any sand and gravel rights for or on behalf of the county conveys full right and title to the lessee to the exclusive use of all sand and gravel deposits in the river bed to the extent embraced in the lease. (Heckerling-Fla)
W69-09890

6816.5 ACRES OF LAND V UNITED STATES (VALUATION OF PROPERTY IN CONDEMNATION PROCEEDING).

411 F2d 834-840 (10th Cir 1969).

Descriptors: *Reservoir construction, *Condemnation, *Condemnation value, *Compensation, Reservoir design, Reservoir sites, Water conservation, Water level fluctuation, Eminent domain, Federal government, Detention reservoir, Legal aspects, Judicial decisions, Recreation, Flow control, Access routes.

Appellant landowner contended that the award granted him in a condemnation proceeding initiated by the United States was inadequate and was based upon speculative assumptions made by government witnesses. The land in question was condemned to be used in the construction of a reservoir as part of a federal water reclamation project. The government's expert witnesses based their suggested award to the condemnee on the value of the land taken and on the alleged increase in value to appellant's remaining land due to its frontage on the new reservoir. The court found the assumed increase in value to be unwarranted since there would be a restricted view of the water from appellant's remaining land. Further, there would be no unique access to the water for appellant, and no direct access to government recreational facilities located at the reservoir. The court stated that the government must rationally and specifically explain

its valuation of the land, and that it could not rely upon speculative or remote possibilities of benefits to appellant in making its award. The case was reversed and remanded for a new valuation of the property. (Kelly-Fla)
W69-09907

DRAINAGE OF ROADBED.

Ark Stat Ann sec 73-627 (1957).

Descriptors: *Arkansas, *Drainage, *Railroads, Ditches, Legislation.

It shall be the duty of any railroad to drain their respective roadbeds in all cases where such lack of drainage has been caused by the roadbed. (Darragh-Fla)
W69-09945

A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER,

Potomac River Basin Advisory Committee, Washington, D.C.

A. C. Watson.
Journal of Soil and Water Conservation Vol 24, No 3, p 89-94, May-June 1969, 6 p, 5 ref.

Descriptors: *Federal government, *Interstate compacts, *Water pollution, *Water quality, *Water resources development, Topography, Rivers, Water gaps, Droughts, Flooding, Sewage, Estuaries, Jurisdiction, Economics of scale, Water supply, Groundwater, Decision-making.
Identifiers: *Potomac River Basin, *Shenandoah, *Great Falls, Gorges, Federal task force, Studies.

This article gives the Potomac River Basin Advisory Committee's recommendation for the 'best possible kind of intergovernmental organization to provide the concerted action needed to solve the problems of the Potomac.' Primarily, the Potomac needed a recognized and accepted basinwide leadership to correlate all the local interests involved in order to make the best use of the available resources. An advisory committee with representatives from Maryland, Virginia, Pennsylvania, West Virginia, and the District of Columbia was formed to fill this need. This committee has launched a concerted effort to control water pollution of the Potomac, aided both by the Federal and local governments concerned with the problem. A compact resulted in the Potomac River Fisheries Commission, that concentrates on water quality problems. This commission if changed to an interstate body would be an intergovernmental agency, able to deal with basinwide problems without affecting its legal base or structural characteristics. In addition, the agency would assure compatibility of various local programs and makes possible efficient long-range planning, economies of scale, and instituting emergency measures. Flexibility would be the key, with the agency responsible for internal organization and administration, being financed by the various governments it served. (Murphy-Rutgers)
W69-09979

THE RANGE OF CHOICE IN WATER MANAGEMENT,

Resources for the Future, Inc., Washington, D.C.
For primary bibliographic entry see Field 05G.

W69-09964

WATER QUALITY CRITERIA.

American Society for Testing and Materials, Philadelphia, Pa.

For primary bibliographic entry see Field 05G.

W69-09967

STANTON V TRUSTEES OF ST JOSEPH'S COLLEGE (RESPECTIVE RIGHTS OF UPSTREAM AND DOWNSTREAM RIPARIAN OWNERS WHEN UPSTREAM USE IS TO BE NON-RIPARIAN).

For primary bibliographic entry see Field 05G.

W69-09968

NEW HORIZONS IN WATER RESOURCES ADMINISTRATION,

Resources for the Future, Inc., Washington, D.C.
For primary bibliographic entry see Field 06B.

W69-09977

CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS, WYOMING UNIV., Laramie.

Frank J. Trelease.

IN Economics and Public Policy in Water Resource Development, Ames, Iowa State University Press, p 272-292, 1965. 21 p, 162 ref. Edited by Stephen C. Smith and Emery N. Castle.

Descriptors: *Water law, *Riparian rights, *Priorities, *Preferences, *Water rights, *Beneficial use, *Reasonable use, Irrigation, Navigation, Streams, Air conditioning, Transportation, Compensation, Water allocation, Mining, Soil conservation, Stock water, Recreation, Fisheries.
Identifiers: *Laissez-faire economics, *Human life and health, Rights, Power, Manufacturing.

This article is designed to acquaint the economist with the law of water use and allocation, covering uses approved by riparian rights and rights of prior application and the situations in which the law has ascribed relative values to competing uses or classes of uses. The legal concepts of reasonable, riparian use and beneficial purpose of appropriation act as only a slight check on water users, while the newer concept of reasonable beneficial use shows an awareness of the economic relativity of specific uses, and the comparative benefits to be realized from different competing uses. However, the preference statutes should be overhauled, giving priority to uses for human life and health, then irrigation and industrial consumption, and finally such things as power and water transportation, for which substitutes can be found. When water is taken from one beneficial use for another, an economic loss occurs, which is less in the case of true preference than in condemnation. However, balky investors may weigh against true preference, since such enterprises are dependent on unstable water rights. Although law serves to balance progress and protection of rights, the future is more dependent on economists, engineers and administrators; thus far, water law has been the handmaiden of progress. (Murphy-Rutgers)
W69-09979

GROUNDWATER LEGISLATION,

Economic Research Service, Washington, D.C.
Economics Div.

Wells A. Hutchins.

IN Economics and Public Policy in Water Resource Development, by Ames, Iowa State University Press, p 293-316, 1965. 24 p, 99 ref. Edited by Stephen C. Smith and Emery N. Castle.

Descriptors: *Public health, *Surface waters, *Flow, *Groundwater, *Water law, *Water rights, *Percolating water, *Riparian rights, Watercourses, Reservoirs, Legislation, Water utilization, Pumping, Drilling, Streams, Taxes, Water pollution, Water supply, Economic feasibility.
Identifiers: *Public opinion, *Public control, Yield, Hydrologists.

This article deals with water rights laws as applied to all water in the ground that is free to move by gravity and to enter wells, and is capable of being extracted from the ground and susceptible to practicable legal control. Groundwater legislation differentiates between percolating waters and definite underground streams; in some areas this distinction has been done away with due to hydrologists' objections. Public opinion has militated against some groundwater legislation, notably drilling and individual pumping clauses, even when they were obviously economically desirable, resulting in serious disputes about the economic feasibility of public control of groundwater rights under appropriation

statutes. However, with the advent of increases in development, it has become increasingly necessary to use the resources of group organizations and public agencies. High court decisions have indicated an increased awareness of the delicate problem of balancing protection of private rights and the public interest in water law cases concerning groundwater. (Murphy-Rutgers) W69-09981

WATERWAYS AND MILDDAMS.

Ky Rev Stat Ann secs 182.010-182.030, 182.130, 182.140 (1963).

Descriptors: *Kentucky, *Dam construction, *Piers, *Bulkheads, Navigable waters, Hydroelectric plants, Federal government, Navigation, Dams, Roads, Boats, Abatement, Legislation, United States, Docks, Saw log test, Streamflow, Barriers, Riparian rights, Navigable rivers.

Identifiers: Houseboats.

No person shall place a dam or obstruction below ten miles from the head of a stream which is navigable for the running of push boats or the floating of sawlogs, staves, or ties. Owners shall remove such existing dams or obstructions as are not erected in accordance with the statutes. This section shall not apply to dams constructed for the purposes of generating electricity for distribution and sale. Any landowner may erect a wharf on his land, or a pier or bulkhead in the watercourse opposite his land. If such wharf, pier, or bulkhead obstructs navigation or injures the private rights of others, the county court may abate it. Persons may petition to erect a wharf at or on any public road. The court may then grant the privilege and fix conditions and limitations and the rates and charges for wharfage. County fiscal courts may indemnify the United States for damages caused by federal improvements. With the exception of steam vessels, all watercraft used as residences upon any navigable watercourse must be licensed. (Marsee-Fla) W69-10008

TENNESSEE TOMBIGBEE WATERWAY DEVELOPMENT COMPACT.

Ky Rev Stat Ann secs 182.300-182.320 (1963).

Descriptors: *Kentucky, *Water resources development, *Tennessee River, *Interstate compacts, Legislation, Interstate rivers, Interstate commissions, Rivers, Project planning, Financing, Water conservation.

The governor of the commonwealth may execute a compact with other states for the development of a navigable waterway connecting the Tennessee and Tombigbee Rivers. The party states establish a joint agency known as the Tennessee-Tombigbee Waterway Development Authority. The Authority shall promote and coordinate the efforts of the party states to secure development of the Tennessee-Tombigbee waterway. The Authority may hold hearings, make reports, cooperate with other public or private groups having an interest in waterways development, formulate and execute plans and policies for the compact, and exercise such other powers as may be appropriate to accomplish its functions. Each party state shall furnish funds necessary for the operations of the Authority. Contributions will not be required from Kentucky beyond the amount necessary to pay the expenses of the Kentucky members of the Authority. The powers provided for in the compact are granted to the governor and to the members of the Authority for Kentucky. (Heckerling-Fla) W69-10010

DAMS.

Vt Stat Ann tit 10, secs 701-719 (1958), as amended, (Supp 1968), 721 (Supp 1968).

Descriptors: *Vermont, *Dams, *Administrative agencies, *Dam construction, Legislation, Legal aspects, Jurisdiction, Water law, Water policy, Water control, Water storage, Dam failure, Dam design, Damsites, Hydroelectric plants, Salmon, Fish management, River regulation, Local governments, State governments, Federal government, Flood control.

The Vermont Water Resources Board has jurisdiction over all dams within the state, except for dams which relate to generation of electric power and fall under the auspices of the Public Service Board. Applications for construction and repair of dams are filed with the selectmen of the town in which the dam is located and with the fish and game commission. Upon a finding by such commission that the propagation of salmon will not be adversely affected, the application is certified to the appropriate agency having jurisdiction for public hearing. The state hydraulic engineer periodically inspects construction progress to insure that approved plans are carried out properly. There is provision for investigations and hearings in reference to the safety of any dam, and necessary action to correct deficiencies may be taken. It is state policy to cooperate with the federal government in flood control efforts, and funds received from the United States for property acquired by it for flood control purposes will be paid to the local government where such property is located. (Johnson-Fla) W69-10027

PUBLIC WATERSHED ASSOCIATIONS.
For primary bibliographic entry see Field 04D. W69-10028

PUBLIC WATERSHED ASSOCIATIONS.
For primary bibliographic entry see Field 04D. W69-10029

PUBLIC WATERSHED ASSOCIATIONS.
For primary bibliographic entry see Field 04D. W69-10030

PUBLIC WATERSHED ASSOCIATIONS.
For primary bibliographic entry see Field 04D. W69-10031

DEPARTMENT OF WATER RESOURCES.
Vt Stat Ann tit 10, secs 571-576 (1958), as amended, (Supp 1968), 575a, 575b, 577-579 (Supp 1968).

Descriptors: *Vermont, *Water conservation, *Administrative agencies, *Water policy, Water law, Legal aspects, Legislation, Water pollution, Water resources, Water resources development, Local governments, State governments, Federal government, Watershed management, Water supply, Water utilization, Interstate compacts, New England Interstate WPS Compact, Flood control, Recreational use, Jurisdiction.

It is state policy that water resources be regulated and controlled in the public interest. The creation of the Vermont water resources board, the advisory commission appointed under the New England interstate water pollution control compact, and other advisory councils is necessitated thereby. The main duty of the Vermont water resources board is the supervision of state water resources including study and investigation of state streams and their basins, cooperation with state soil and water conservation districts, supervision over flood control, encouragement of recreational uses of water, and prevention of water pollution. The water resources department carries on a continuing study of groundwater in the state. The water resources board cooperates with federal and state governments in the interest of state water resources and is the agency of the state which aids municipalities in the development of local water supplies. Board

members or their agents may enter upon private lands for the purpose of inspecting and investigating conditions relating to water pollution. (Johnson-Fla) W69-10032

WHARF LINES AND BULKHEADS.

Del Code Ann tit 23, secs 1501-1511 (1953), as amended, (Supp 1966).

Descriptors: *Delaware, *Docks, *Bulkhead line, *Landfills, Land forming, Bulkheads, Piers, Piles (Foundations), Coastal structures, Land, Land development, Legislation, Water law, Water policy, Legal aspects, Land management, Shore protection, Riparian land, Riparian rights, Competing uses, Relative rights, Water utilization.

The City Council of New Castle has the power to limit the length of wharves and require such sluice ways as are deemed necessary; violators may be fined and their wharves subject to removal. Similar provisions extend to areas on the Laurel River except that the Levy Court of Commissioners of Sussex county hears complaints concerning violation of wharf line restrictions. Such restrictions apply to all wharves, platforms, landing places, marine railways, piers, piles, and abutments which lie within the restricted areas. The town of Laurel is not prevented in any way from constructing proper sluices, culverts, and waste ways for the drainage of the town. Filling may not be done between certain points established by this section beyond established bulkhead lines. Except for duly authorized piers, no structure is allowed beyond bulkhead lines. Littoral proprietors may fill from their shore to the bulkhead lines established by this section, and title to such fill vests in the owners in fee simple. Disputes over new water frontage subsequent to filling to the bulkhead line are settled by the attorney general. (Johnson-Fla) W69-10033

SEWAGE DISPOSAL SYSTEMS ON ISLANDS.

NH Rev Stat Ann secs 149-C:1 thru 149-C:7 (Supp 1967).

Descriptors: *New Hampshire, *Sewage disposal, *Islands, *Regulation, Administrative agencies, Water pollution control, Water pollution abatement, Fresh water, Ponds, Marshes, Landfills, Construction, Zoning, Permits, Cities, Planning, Legislation, Legal aspects, Sewage.

Identifiers: *Enforcement, Fines, Great ponds.

In order to prevent pollution of public waters, any person proposing construction of a sewage disposal system on any island surrounded by fresh water shall submit plans for the system for approval in accordance with zoning ordinances, or if such ordinances are not applicable such plans shall be submitted to the Water Pollution Commission for approval. No sewage system shall be constructed without written approval. No person shall fill a marsh bordering on a great pond in order to erect a building thereon without written approval from the appropriate authority. The Water Pollution Commission shall administer and enforce this act. The Commission may issue cease and desist orders to halt unauthorized construction or use of sewage systems on islands. Any person failing to obey commission orders shall be fined up to \$500 for each day of violation. (Harris-Fla) W69-10034

WATER POLLUTION AND DISPOSAL OF WASTES.

For primary bibliographic entry see Field 05B. W69-10035

WATER POLLUTION AND DISPOSAL OF WASTES.

For primary bibliographic entry see Field 05B. W69-10036

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

WATER POLLUTION AND DISPOSAL OF WASTES.

For primary bibliographic entry see Field 05B.
W69-10037

WATER POLLUTION AND DISPOSAL OF WASTES.

For primary bibliographic entry see Field 05B.
W69-10038

FUTURE SUPPLIES OF WATER FOR DOMESTIC USE.

NH Rev Stat Ann secs 148-A:1 thru 148-A:5 (1964), as amended, (Supp 1967).

Descriptors: *New Hampshire, *Domestic water, *Planning, *Water supply, Water sources, Cities, Administrative agencies, Public health, Legislation, Potable water, Water resources development, Future planning, Long-term planning, Human population, Legal aspects.

There is a state-wide need for long-range planning to insure adequate water supplies for domestic use. The Department of Health and Welfare, Division of Public Health Services, is authorized to study future domestic water supply requirements of cities appearing to have increased industrial and population growths in the next 50 years. The most feasible sites for sources of water shall be determined by the study. The Division may employ engineers and other assistance to aid in the studies. Studies shall be reported to the state legislature with recommendations for acquisition of future sites. Upon request, the Division shall consult with and give advice to any municipality considering a change in its domestic water supply due to an approaching critical situation. (Harris-Fla)
W69-10039

TESTING OF WATER SUPPLIES.

NH Rev Stat Ann sec 131:3 (1964).

Descriptors: *New Hampshire, *Public health, *Water sources, *Regulation, Administrative agencies, Water quality, Water supply, Recreation, Water purification, Domestic water, Potable water, Public utilities, Legislation, Schools, Investigations, Inspection.

The Department of Health and Welfare Division of Public Health Services shall make periodic inspections, analyses, and investigations of public water supplies. When requested or deemed necessary, the Board of Health may also inspect and analyze sources furnishing water to institutions, schools, hotels, camps, and other public resorts. The Board shall enforce laws pertaining to water supply and sanitation of public waters. (Harris-Fla)
W69-10040

WATERCOURSES AND CUTS GENERALLY.

SC Code Ann secs 70-163, 70-164 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Condemnation value, *Condemnation, *Inland waterways, Land tenure, Compensation, Financing, Local governments, Legal aspects, Legislation, Docks, Shores, Eminent domain, Land use.
Identifiers: *Tolls.

The owner of the shore of, or any wharf in or over, the navigable streams of the state may charge reasonable tolls for the use thereof. If necessary to acquire a right of way or outlet in, over, or through any land for construction of inland waterways, and the county and owner cannot agree on the price of the land, condemnation proceedings shall be instituted pursuant to article 9, section 20 of the Constitution of 1895, and the applicable statute. Compensation shall be paid from the general county fund when approved by a majority of the county legislative delegation. Condemnation proceedings are appealable. (Harris-Fla)
W69-10041

RULES OF THE INTERNAL IMPROVEMENT FUND OF THE STATE OF FLORIDA SOVEREIGNTY SUBMERGED AND TIDAL LANDS IN COASTAL AND INTRACOASTAL WATERS.

Fla Admin Code Chap 200-2 (1968).

Descriptors: *Florida, *Regulation, *Intertidal areas, *Bulkhead line, Legislation, State jurisdiction, Riparian rights, Public rights, Tidal water, High water mark, Low water mark, Islands, Sandbars, Shallow water, Tides, Recreation, Docks, Dredging, Jetties, Legal aspects, Administrative agencies.

Identifiers: Tidal lands.

Sovereignty submerged and tidal lands include such areas of the bottom lands of meandered fresh waters connected with or flowing into coastal and intracoastal navigable waters as are subject to tidal flow. Criteria to be considered in establishing or altering the bulkhead line are: (1) free use of public waters; (2) recommendations of the state board of conservation; (3) upland erosion, shoaling of channels, accretion, and tidal currents; (4) effects on adjacent or nearby upland property values; (5) natural beauty; (6) beach erosion control; (7) general area problems. Commitments for public rights-of-way shall conform to the regulations set forth herein. Commitments of sovereignty lands for limited or restricted uses are considered by the trustees. Bulkhead line establishment and permit acquisition is a prerequisite to corporate filing of sovereignty lands. Material from sovereignty lands used to fill private land and upland must be purchased. (Moulder-Fla)
W69-10042

CANALS AND WATERWAYS, RIVERS, LAKES, STREAMS.

III Ann Stat ch 19, secs 52-78 (Smith-Hurd 1963), as amended, (Supp 1969).

Descriptors: *Illinois, *Administrative agencies, *Riparian rights, *Navigable waters, Local governments, State governments, Permits, Non-navigable waters, Navigation, Encroachment, Docks, Channels, Data collections, Drainage, Construction, Reclamation, Beds, Harbors, Electric power, Natural resources, Legislation, Great Lakes, Water levels, Regulation.

The Department of Public Works and Buildings has jurisdiction over all Illinois lakes and streams in which the state has any rights or interests. The department shall investigate every encroachment on public waters and hold hearings of complaints concerning the waters, navigation, docks or related topics. It shall gather data concerning deep waterways and navigable waterbodies and plan for the beautification of state waters. It shall furnish information to anyone desiring to reclaim land as to cost or feasibility. No structure or fill may be constructed upon public waters without first obtaining a permit from the department. The department, upon issuance of a permit, may allow the taking of minerals or substances from beds of public waters or the construction of harbors in certain areas. The department shall plan for the establishment of preserves for recreation along public waters. It shall gather data concerning water power, natural resources, propagation of fish, and flood control. It shall also establish water levels and require proper dam maintenance. Any drainage district, before increasing the flow of any stream, must obtain a permit from the department. (Darragh-Fla)
W69-10043

ILLINOIS WATERWAY.

III Ann Stat ch 19, secs 79-106 (Smith-Hurd 1963).

Descriptors: *Illinois, *Inland waterways, *Channels, *Construction, Powerplants, Water storage, Local governments, Maintenance, Condemnation, Bridges, Tunnels, Public utilities, Eminent domain, Damages, Legislation, Cities, Administrative agencies.

Identifiers: Permits, Drainage systems, Operation and maintenance.

A deep waterway, to be known as the Illinois Waterway, shall be constructed from Chicago to the Illinois River. Construction, maintenance, and control is vested in the department of public works. The department is empowered: to prepare plans for construction; to use or lease excess water or power; to construct and maintain powerplants and water storage facilities; to establish and collect tolls; to prescribe rules and regulations; to acquire property by donation, purchase or condemnation; to enter upon and use all lands or water necessary; to repair, replace, or reconstruct public bridges; to sell equipment or land no longer needed; to allow public utilities or municipalities to use any tunnels constructed to contain power lines; to hire personnel; to apply for federal permits; and to make contracts. The department shall make compensation for any interference to private property taken or damaged through contract or eminent domain. The department may use public property. If any drainage system or bridge is interfered with during construction, it shall be repaired. The state is liable for damages to person or property resulting from the construction of or overflowing from the waterway. (Darragh-Fla)
W69-10044

ILLINOIS AND MISSISSIPPI CANAL-STATE PARK.

III Ann Stat ch 105 secs 482a-482d (Smith-Hurd Supp 1969).

Descriptors: *Illinois, *Canals, *Parks, *United States, Legislation, Lakes, Administrative agencies, Operation and maintenance, Conservation, Land tenure, Dams, Mississippi, Construction, Railroads, Bridges, Contracts, Recreation facilities, Water management (Applied), Easements, Legal aspects.

The Department of Conservation and the Department of Public Works and Buildings are authorized to enter into agreements with the United States to allow the United States to acquire title to the lands in the lake created by the government dam constructed across Rock River and in all other lands upon which the United States has rights or easements used for the purpose of the Illinois and Mississippi Canal. The Department of Conservation may accept a quitclaim deed from the United States to all right, title, and interest of the United States in the canal. Upon the acceptance of the title, and canal shall become a State Park under the care, control, supervision, and management of the Department of Conservation. This control is subject to certain enumerated exceptions. (Heckerling-Fla)
W69-10045

POWER TO ACQUIRE PIERS AND BEACHES.

III Ann Stat ch 24, sec 11-93-1 (Smith-Hurd 1962).

Descriptors: *Illinois, *Eminent domain, *Recreation facilities, *Cities, Legislation, Beaches, Piers, Navigable waters, Public benefits, Land tenure, Land use, Legal aspects.

The corporate authorities of each municipality may acquire by eminent domain private lands bordering upon public or navigable waters which are useful or desirable for bathing beaches and recreation piers. (Heckerling-Fla)
W69-10046

LEVEE IMPROVEMENT COMMISSION.

III Ann Stat ch 24, secs 11-114-1 thru 11-114-3 (Smith-Hurd 1962).

Descriptors: *Illinois, *Levees, *Administrative agencies, *Cities, Legislation, Bonding, Navigable waters, Lakes, Shores, Rivers, Parks, Operation and maintenance, Facilities, Local governments, Legal aspects.

Identifiers: *Improvements.

The corporate authorities of a municipality with a population of less than one-half million which is bounded by or through which flows a river or is contiguous to or contains within its corporate limits a portion of a navigable lake may provide for the creation of a levee improvement commission. Such commission has full control and supervision of all improvements, docks, levees, industrial developments and facilities including terminals and parks on the river front or lake shore and the land, whether developed or undeveloped approximate to the river front or lake shore located within the corporate limits of the municipality. Such commission may expend money over which it has control for the construction, operation, or maintenance of improvements, docks, levees, industrial developments, and facilities, including terminals and parks on the river front or lake shore or for land over which the commission has control. The corporate authorities may issue bonds for the purposes authorized. (Heckerling-Fla)

W69-10047

STATE AID IN FLOOD CONTROL; MUNICIPAL-FEDERAL FLOOD CONTROL PROJECTS.

III Ann Stat ch 24, secs 11-115-1, 11-115.1-1 (Smith-Hurd 1962), as amended, (Supp 1969).

Descriptors: *Illinois, *Federal government, *Contracts, *Flood control, Cities, Legislation, Administrative agencies, Regulation, Bridges, Pollution abatement, Flood protection, Easements, Right-of-way, Damages, Construction, Projects, Operation and maintenance, Construction costs, United States, Flood routing, Waste dumps, Landfills.

Whenever the state appropriates money for the construction of works to protect against floods, the authorities of any municipality benefited may contract with the state to take over and maintain the works. Any city may contract with the United States that with reference to any flood control project constructed by the United States it will: (1) provide lands, easements, and rights-of-way without cost, (2) contribute part of the construction costs, (3) hold and save the United States free and harmless from claims of damages resulting from such construction, (4) maintain and operate all works after completion, (5) establish and enforce flood channel limits for protection of any flood channel, (6) prevent dumping of waste material or the creation of fills within any flood channel limits, and (7) regulate the construction of bridges or other structures crossing any waterway. (Heckerling-Fla)

W69-10048

WATER SERVICE DISTRICT.

III Ann Stat ch 111 2/3, secs 213-222.1 (Smith-Hurd 1966), as amended, (Supp 1969).

Descriptors: *Illinois, *Water districts, *Local governments, Cities, Taxes, Tax rate, Costs, Financing, Compensation, Legislation, Boundaries (Property), Governments, Water supply, Contracts.

Identifiers: Water mains.

Nonincorporated areas may be incorporated as a water service district upon petition, notice and hearing before the county judge. The voters in the proposed district must approve the incorporation. The board of trustees are appointed to manage the district, sell water, and pass ordinances necessary for the management of the district. The board may contract to furnish water to adjacent incorporated towns or public utilities and may install mains to furnish water to the district. Bond issues will be passed by the voters and financed by an annual tax. Adjoining territory may be annexed if approved by the voters. Adjoining land owners can be disconnected from the district. (Darragh-Fla)

W69-10049

MUNICIPAL BRIDGES, FERRIES, AND TERMINALS.

III Ann Stat ch 121, secs 10-601 thru 10-604 (Smith-Hurd 1960).

Descriptors: *Illinois, *Cities, *Bridges, *Boats, Legislation, Operation and maintenance, Construction, Bonding, Regulation, Rivers, Boundaries (Surfaces), Facilities, Transportation, Legal aspects.

Identifiers: *Ferries.

The corporate authorities of any municipality have the power to acquire by purchase, lease, or gift, ferries, bridges, the approaches thereto, and land adjacent to each ferry or bridge. Each municipality has certain powers with regard to: (1) the acquisition and maintenance of the ferries and bridges; (2) rivers forming the boundary line of this state; (3) aiding road districts; (4) issuing bonds; and (5) collecting tolls. Every bridge and ferry and also approaches thereto which are controlled by the municipality are subject to municipal control or ordinances the same as though the bridge or ferry were situated within the corporate limits of the municipality. Every municipality of less than 500,000 inhabitants which is located on a navigable stream has the power to acquire, construct, maintain, and operate either within or without its corporate limits bridges and approaches, and transportation and other terminal facilities. (Heckerling-Fla)

W69-10050

STATE HIGHWAYS.

III Ann Stat ch 121, secs 4-201, 4-201.9, 4-201.13 (Smith-Hurd 1960).

Descriptors: *Illinois, *Highways, *Bridges, *Administrative agencies, Legislation, Construction, Operation and maintenance, Navigable waters, Streams, United States, Contracts, Leases, Rivers, Transportation, Bridge construction.

Identifiers: *Ferries.

The Department of Public Works and Buildings shall have the power (1) to construct, purchase, lease or otherwise acquire, and (2) to operate without charge to the public, ferries over rivers and other waters upon any state highway, whether permanently or temporarily located, until such time as it is deemed feasible and desirable to construct bridges at such places. The Department may also construct, maintain, and operate bridges across any stream between this state and any adjoining state where bridge is necessary to connect the federal-aid highway network in this and such adjoining state and enter into agreements with adjoining states, persons, and the United States government in conjunction therewith. (Heckerling-Fla)

W69-10051

EMINENT DOMAIN.

Iowa Code Ann secs 471.11 to 471.14 (1949).

Descriptors: *Iowa, *Eminent domain, *Condemnation, *Diversion, Legislation, Alteration of flow, Legal aspects, Land tenure, Railroads, Overflow, Dams, Reservoirs, Streams, Excavation, Channels, Ditches, Administrative agencies, Water users, Access routes, Public utilities.

Lands which are sought to be condemned for water stations, dams, or reservoirs, including all overflowed lands, shall, if requested by the owner, be set aside in a square or rectangular shape by the state commerce commission. An owner of land which has been condemned shall not be deprived without his consent of access to the water or use thereof, in common with the water company, on his own land nor, without his consent shall his dwelling, outhouses, or orchards be overflowed or otherwise injuriously affected by such condemnation. A railroad which has the right to excavate a channel and thereby change the course of a stream

may by condemnation or otherwise acquire sufficient land on which to excavate such ditch or channel. Nothing in the above section shall give such railroad the right to change the course or any stream or watercourse where such right does not otherwise exist nor without the owners' consent to divert such stream from any cultivated land when it only touches such lands at one point. (Heckerling-Fla)

W69-10052

STATE CONSERVATION COMMISSION.

Iowa Code Ann sec 107.21, 107.24 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Conservation, *Administrative agencies, *Fish, Fish conservation, Legislation, Regulation, Condemnation, Leases, State governments, Public benefits, Fish hatcheries, Fish management, Fish stocking, Fisheries.

The department of conservation shall consist of the following divisions: (1) a division of fish and game which shall include matters relating to fish and fisheries; (2) a division of lands and waters which shall include matters relating to state waters, lakes and streams; and (3) a division of administration. The State Conservation Commission is authorized to: (1) acquire by purchase, condemnation, lease, gift and devise lands or waters suitable for the following purposes: (a) public fishing grounds and waters to provide areas in which any person may fish in accordance with the law and (b) fish hatcheries, fish nurseries, game farms and fish refuges; (2) extend and consolidate waters suitable for the above purposes by exchange for other waters; (3) capture, propagate, buy, sell, or exchange any species of fish needed for stocking the lands or waters of the state; and (4) control by shooting or trapping any fish for the purpose of preventing the destruction of or damage to private or public property. (Heckerling-Fla)

W69-10053

PUBLIC USE OF PRIVATE LANDS AND WATERS.

Iowa Code Ann secs 111C.1-111C.7 (Supp 1969).

Descriptors: *Iowa, Recreation, Land tenure, Public benefits, Damages, Legal aspects, Legislation, Recreational facilities, Water utilization, Water resources development.

Identifiers: Liability.

The purpose of this chapter is to encourage private owners of land to make land and water areas available to the public for recreational purposes by limiting their liability toward persons entering thereon for such purposes. Except as otherwise provided, a landowner owes no duty of care in keeping premises safe or warning of dangerous conditions to persons entering for recreational purposes. Persons entering land for recreational purposes without charge shall not be considered invitees or licensees. Liability lies against a landowner when he willfully and maliciously fails to guard or warn against a dangerous condition or when he charges the persons entering on his land for the recreational use thereof. (Heckerling-Fla)

W69-10054

WATER RECREATIONAL AREAS.

Iowa Code Ann secs 111.59-111.78 (Supp 1969).

Descriptors: *Iowa, *Recreation facilities, *Cities, *Water resources development, Legislation, Legal aspects, Public benefits, Permits, Contracts, Condemnation, Financing, Drainage districts, Conservation, Administrative agencies, Levees.

Identifiers: *Water recreational areas.

Municipalities may establish water recreational areas and when established without state funds, the municipality shall have exclusive control of such areas. Municipalities must petition the state conser-

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

vation commission in order to establish a water recreational area without public funds. Any lake in the water recreational area shall be permanently subject to and available for free public access use. The state conservation commission shall keep a record of all permits granted and issued by it showing when and to whom issued and the location of the proposed water recreational area. If a municipality cannot acquire land necessary for the area at a reasonable price, they may condemn such land. Such condemnation shall be limited to land and interests which will be permanently subject to and available for free public access and use or will be required for dam or other facilities necessary for the water recreational area. The county boards and trustees having control of any levee or drainage district established thereunder may enter into contracts and agreements with municipalities authorized to establish water recreational areas under the provisions of this act. (Heckerling-Fla) W69-10055

BRIDGES.

Iowa Code Ann secs 381.1, 381.9-381.20 (1949), as amended, (Supp 1969), sec 381.7 (Supp 1969).

Descriptors: *Cities, *Bridges, *Construction, *Iowa, Repairing, Culverts, Tax, Tax rate, Legislation, Bridge construction, Railroads, Rivers, Navigable waters, Local governments, Contracts, Legal aspects.

Cities have the care, supervision, and control of all public bridges, culverts, and viaducts within their corporate limits and which are not owned by any railroad. They may also aid in the construction of county bridges within the city limits or bridges across any unnavigable river dividing the county from another state. Cities may also vote to aid in the construction of county bridges or bridges across a navigable boundary river of the state. A city of 5,000 population or more may, after proper notice, vote a tax to finance the construction of any desired bridge. Cities are empowered to contract with any railroad, corporation, or person who privately owns a bridge for its use as a public bridge. Such a contract may be financed by a tax which may be secured by a bond issue. (Darragh-Fla) W69-10056

WATER SUPPLY, DRAINAGE AND FLOOD CONTROL.

III Ann Stat ch 34, secs 3101-3114 (Smith-Hurd 1960), as amended, (Supp 1969).

Descriptors: *Illinois, *Water control, *Flood control, *Drainage, Water supply, Local governments, Administrative agencies, Federal government, Financing, Contracts, Ditches, Levees, Dikes, Reservoirs, Rivers, Streams, Sewage, Sewers, Basins, Water works, Taxes, Water rights, Water pollution, Flow control, Sewage disposal.

The board of supervisors of any county contiguous with another county of 1,000,000 or more population may establish a department of public works to supervise projects dealing with water supply, drainage, and flood control. A tax levy passed by the voters in the interested county will provide funds. In order to protect, reclaim or irrigate county land the county board may improve any existing water facility and purchase or condemn any publicly or privately owned facility necessary for the proposed plan. The board may control the flow of rivers within county boundaries if such control does not interfere with vested water rights. A city lacking its own water works program may pass an ordinance allowing it to contract with the county for water. The county board has the power to acquire land, build dams and reservoirs, sink wells, purify water, and establish rates for the use of water. The board may also regulate the disposal of sewage and construct and maintain sewers. The county board may contract with federal agencies located within the county. (Darragh-Fla) W69-10057

UNITED STATES V 930.65 ACRES OF LAND IN JEFFERSON COUNTY (VALUATION OF LAND WITHOUT WATER SUPPLY).

299 F Supp 673-679 (DC Kan 1968).

Descriptors: *Condemnation value, *Eminent domain, *Property values, *Water values, Market value, Assessments, Land tenure, Access routes, Projects, Flood control, Water control, Legal aspects, Judicial decisions.

Identifiers: Development land, Land valuation.

Plaintiff United States initiated condemnation proceedings to take a portion of defendant's land for flood control purposes in the Missouri River basin. The value of defendant's pasture land before taking was \$100 per acre, and the Commission found no decrease in value for the 34.85 acres remaining after the taking. Defendant landowner contended the land was still pasture and was merely of nominal value after the taking, while the Commission contended the remainder was development land. The United States district court recognized that the remaining land was left inaccessible and without water or suitable pond site and held that the Commission finding was erroneous and based upon an improper rule of valuation which measured compensation by the difference between the market value unenhanced by the project and the market value of the remainder including enhancement by the project. The court noted the correct rule to be that compensation includes the incidental injury or benefit to the part not taken. The court held the possibility of land development to be remote and speculative and not sufficiently certain of realization to be considered an enhancement of the property. (Harris-Fla) W69-10058

BROWN V ELLINGSON (WITHDRAWAL OF LAKE WATER).

224 So2d 391 - 395 (DCA Fla 1969).

Descriptors: *Florida, *Withdrawal, *Lakes, *Water levels, Legislation, Judicial decisions, Water level fluctuations, Riparian rights, Canals, Ditches, Pumping, Drainage, Recreation, Shores, Legal aspects, Water law.

Identifiers: Injunctions (Prohibitory).

Plaintiff sought to have defendants enjoined from drawing water from a lake greater than two square miles in area. Defendants failed to obtain the written consent of abutting landowners as required by Florida Statute. Plaintiff further alleged that defendants thereby infringed upon his common law rights as a riparian owner by lowering the water level of the lake so as to expose the lake bottom. The trial court held that the statute did not apply because its terms were limited to situations where the lowering of the water level was caused by a drainage canal or ditch. The appellate court held that the complaint had stated a cause of action pursuant to the statute and that plaintiff was only required to show that the level of the lake had been lowered below its normal level as a direct result of defendants' pumping operations. The court was also of the opinion that plaintiff's complaint stated a cause of action in stating that his common-law riparian rights had been violated. (Heckerling-Fla) W69-10059

LEGAL ASPECTS OF CROSS CONNECTION INSPECTIONS,

Ernest H. Campbell.

Am Waterwks J, Vol 61, No 8, p 409-412, Aug 1969. 4 p, 11 ref.

Descriptors: *Plumbing, *Pipes, *Inspection, *Potable water, Disposal, Domestic wastes, Judicial decisions, Regulation, Control, Water pollution, Water pollution control, Public health, Water quality control, Water supply.

Identifiers: *Cross connections.

Cross connections in pipelines are connections where safe water inadvertently comes into contact

with contaminating fluids. Liability problems arise from the use or consumption of this unsafe water. Often the supplier does not have access to all pipes that may contain potential cross connections. However, this in many cases will not free him from liability for injury. Inspection of all pipes within a water system is essential to protect users from harm. In order to gain access to all pipelines, there may be a need to resort to search warrants. Recent Supreme Court decisions have affected the area of warrantless searches, and it is now fairly clear that warrants are required if entrance for such inspections is refused. Cross connections should be eliminated where possible, or at least minimized and rigorously inspected so as to safeguard against the spread of disease. (Darragh-Fla) W69-10060

WATER DRAINAGE AND LEVEE DISTRICTS.

Ark Stat Ann secs 21-801 thru 21-858 (1968).

Descriptors: *Arkansas, *Drainage districts, *Flood control, *Administrative agencies, Project planning, Federal government, Drainage systems, Project purposes, Channel improvement, Diversion structures, Flood protection, Levees, Watershed management, Legislation, Legal aspects, Drainage, Drainage programs, Easements, Condemnation, Eminent domain, State governments.

The board of directors of any levee or drainage district is authorized by statute to contract with the federal government concerning drainage and flood control projects. The board is granted certain operational powers, including the power to provide land or servitudes over land for projects. The increased value of land, by reason of the construction of a project, is determined by each district's board of assessors, and taxes are assessed accordingly. The procedures by which assessments are made and collected and grievances are settled are set forth. The boards of directors of the districts are generally responsible for maintaining their drainage and flood control projects in good repair. The flood control and drainage projects authorized by the state legislature may be consolidated by the districts with the local projects for which they were originally created. The powers and duties of the districts regarding the general projects are the same as those associated with the original local projects. (Kelly-Fla) W69-10061

WATER DRAINAGE AND LEVEE DISTRICTS.

Ark Stat Ann, secs 21-801 thru 21-809 (1968).

Descriptors: *Arkansas, *Drainage districts, *Flood control, *Project planning, Federal government, Drainage systems, Administrative agencies, Project purposes, Diversion structures, Flood protection, Levees, Watershed management (Applied), Legislation, Legal aspects, Drainage programs, Easements, Condemnation, Eminent domain, Mississippi River, Contracts, Highways, Reservoirs, Public benefits, Assessments.

Improvement district commissioners shall be elected from all combination levee and drainage districts which embrace all the lands within the corporate limits of a city. The board of directors of any levee or drainage district is authorized to contract with the federal government concerning any flood control or drainage project on the Mississippi River or its tributaries. The board may acquire land or servitudes over land in discharge of such obligations. Condemnation may be used by the board in acquiring land. The governor and secretary of state may convey to the board of any district, or to the federal government, rights of way for levees, levee foundations, channel rectifications, reservoirs, reservoir sites, spillways, drainage canals, and easements for flowage and storage rights over state lands. The highway commission shall make similar grants if flood control or drainage works contemplated by the district or by the federal government will extend across state highways. The state govern-

ment consents to the use of eminent domain by the United States for acquisition of land, flowage rights, and easements for authorized federal projects. (Kelly-Fla)
W69-10062

WATER DRAINAGE AND LEVEE DISTRICTS.

Ark Stat Ann, secs 21-810 thru 21-827 (1968).

Descriptors: *Arkansas, *Drainage districts, *Flood control, *Project planning, Drainage systems, Project purposes, Diversion structures, Flood protection, Levees, Watershed management (Applied), Legislation, Legal aspects, Drainage programs, State governments, Construction, Assessments, Construction costs, Contracts, Federal government, Bayous, Cost-benefit analysis, Cost-benefit ratio.

The board of assessors of each levee or drainage district, in which flood control and drainage works may be constructed, is empowered to determine and record the increase in value accruing to all real property within the district by reason of the construction. The assessment is subject to review by the equalization board and by the chancery court. The statute outlines the procedures by which assessments are made and collected and by which grievances are settled. Before a district can exercise the powers conferred by the statute, it must provide an outline of the project being undertaken and secure the approval of the board of directors and of the district's landowners. The district is authorized to execute all proper contracts with the United States to provide lands, rights of way, and easements necessary for straightening, cleaning out, and deepening bayous that serve as natural drainage for such district. The board of directors must first determine, however, that the benefits of the proposed work are general to the whole district and that the benefits are equal to the costs. (Kelly-Fla)
W69-10063

WATER DRAINAGE AND LEVEE DISTRICTS.

Ark Stat Ann, secs 21-827 thru 21-858 (1968).

Descriptors: *Arkansas, *Drainage districts, *Flood control, Project planning, Federal government, Drainage systems, Administrative agencies, Project purposes, Channel improvement, Diversion structures, Flood protection, Levees, Watershed management (Applied), Legislation, Legal aspects, Drainage programs, Easements, Condemnation, Eminent domain, State governments, Construction costs, Construction, Contract administration, Ditches, Watershed management, Operation and maintenance, Repairing.

When any levee or drainage district has given assurances to the federal government that the district will maintain and manage a drainage facility constructed by the United States, the board of commissioners of the district is responsible for carrying out such management. The Corps of Engineers may file written objections with the officers of any district which fails to comply. If the district fails to act, the state attorney general may bring mandamus action in the appropriate court. The board of commissioners of any drainage district may purchase or rent such machinery and equipment as is needed in repairing, deepening, or clearing ditches or levees in its district. The flood control and drainage projects authorized by the state legislature in general acts (1949) may be consolidated by the drainage and levee districts with the projects for which they were originally created. The duties, obligations, and powers attendant to the original projects may be consolidated by the districts with those associated with the general acts. (Kelly-Fla)
W69-10064

ARKANSAS IRRIGATION, DRAINAGE AND WATERSHED IMPROVEMENT DISTRICT ACT OF 1949.

Ark Stat Ann secs 21-901 thru 21-934 (1968).

Descriptors: *Watershed Protection and Flood Prevention Act, *Arkansas, *Irrigation districts, *Drainage districts, Legislation, Administrative agencies, Taxes, Tax rate, Operating costs, Assessments, Boundaries (Property), Contracts, Bonding, Flood control, Sediment control, Construction, Benefits, Damages, Project benefits, Flood damage, Operation and maintenance.
Identifiers: Watershed district.

This act provides for the organization, operation and maintenance of irrigation, drainage, and watershed districts for the general purposes of: (1) preventing erosion, flood water and sediment damages in river and stream watersheds; (2) establishing irrigation systems; (3) coordinating irrigation, flood control, and drainage improvements; and (4) cooperating with the federal government in furthering the objectives of the Watershed Protection and Flood Prevention Act. Procedures for the establishment of such districts and the specific purposes for which districts may be organized are set forth, as are procedures for establishing district boundaries. The governing body of each district is a board of commissioners possessing the powers herein enumerated. Provision is made for the assessment of benefits and damages accruing to landowners by reason of proposed improvements, and a tax levy is provided to pay the estimated cost of such improvements. Districts are also authorized to tax, to maintain proper service, to reassess benefits, to borrow money, to issue bonds, to control construction of improvements, and to enter contracts with the United States. Provisions for the extension of taxes, the time for payment of taxes, and the collection of taxes are included. (Marsee-Fla)
W69-10065

IMPROVEMENT DISTRICTS OF RIVER WATER - DRAINAGE AND LEVEE DISTRICTS.

Ark Stat Ann secs 21-1001 thru 21-1013 (1968).

Descriptors: *Arkansas, *United States, *Water management, *Drainage districts, Levees, Financing, Local governments, Legislation, Judicial decisions, Taxes, Tax rate, Assessments, Damages, Benefits, Eminent domain, Federal government, Legal aspects, Planning.

When the United States Congress has adopted an improvement plan for waters bordering on Arkansas, then 10 or more owners of real property within the adopted area may petition the circuit court to establish an improvement district. The circuit court shall hold a hearing to grant or deny the petition. This order is appealable. Commissioners shall be appointed by the court, and they shall assess benefits and damages to property owners. The court shall order a tax levy. The federal plan will be the plan used by the local district. The districts have full power to enter into a contract of assurance with the federal government and to perform all acts required by the federal government, and to exercise the right of eminent domain. The districts thus organized shall have all the rights and powers of locally organized drainage and levee districts. (Darragh-Fla)
W69-10066

ARTESIAN WELLS.

Ark Stat Ann secs 21-1101 thru 21-1108 (1968).

Descriptors: *Arkansas, *Artesian wells, *Well regulations, *Water pressure, Legislation, Underground, Well spacing, Wells, Water wells, Sub-surface waters, Pressure, Water sources, Confined water, Groundwater, Water supply, Water allocation (Policy), Water rights, Preferences (Water rights), Consumptive use, Legal aspects.

Any occupier of land who is dependent upon an artesian well for his domestic water supply, who finds that well pressure has become inadequate for his plumbing system, and who knows of an abandoned, unused well within one mile may file a complaint

petition with the county judge. The judge serves notice of the complaint on the owner of the unused well, and if he does not seal it within ten days of notice, the judge will order it sealed. For those wells sealed by the county, a \$100 expense statement will be filed with the recorder as a part of the deed for the land, and such deed cannot be recorded without payment of the expenses on record. This act is retroactive to cover wells abandoned prior to its passage. (Doublerley-Fla)
W69-10067

WATER CONSERVATION COMMISSION.

Ark Stat Ann secs 21-1301 thru 21-1315 (1968).

Descriptors: *Arkansas, *Reservoir storage, *Dams, Legislation, Water storage, Retention, Surface water, Water distribution (Applied), Water shortage, Water supply, Water control, Water management (Applied), Water allocation (Policy), Administrative agencies, Competing uses, Distribution, Equitable apportionment, Preferences (Water rights), Water contracts, Water consumption, Riparian rights, Detention reservoirs, Multiple-purpose reservoirs, Permits, Dam construction.

After notice and hearing, the Arkansas Soil and Water Conservation Commission may issue permits for construction of dams and allocate the taking of waters during shortages. Any person may be issued a permit if: (1) plans and specifications of construction and operation are submitted; (2) water is to be discharged to approximate flow without the dam; and (3) applicant has the right to occupy flooded lands. Permits cannot exceed 50 years and may be cancelled for non-compliance. The permit holder has exclusive rights to take water from the reservoir, except that the owner of land on which water is unlawfully impounded has a right to that water and may sue for damages. In case of water shortage, the Commission may allocate water to those affected in the following order of preference: uses 91) sustaining life, (2) maintaining health, and (3) increasing wealth. Any person may acquire rights to water in government reservoirs by contract, and notice of such intent to contract must be given to the Commission. The act does not cover natural lakes, rainwater, floodwater or springs on an individual's property. Yearly fees for permits and penalties for violations are provided. (Doublerley-Fla)
W69-10068

WATER POWER COMPANIES.

Ark Stat Ann secs 73-2001 thru 73-2019.

Descriptors: *Arkansas, *Hydroelectric plants, *Dam construction, *Electric power production, Powerplants, Erection, Dams, Legislation, Damages, Compensation, Administrative agencies, Local governments, State governments, United States, Fish passages, Construction, Hydroelectric power, Legal aspects, Assessments, Taxes, Eminent domain.

All water power in the state is a part of the public domain. Any person or corporation can procure a charter from the state authorizing the erection of a dam across a stream or river for the purpose of producing electric power. An application for use of the power produced shall be made to the Railroad Commission, and said Commission at its discretion can require the applicant to construct a fish chute sufficient for easy passage of fish. The power shall be for public use and may be sold to private parties. If the power is to be used privately by the producer, he will be required to pay a tax for such use. The power of eminent domain may be exercised by such authorized corporations, and damages, assessment, and compensation will be established in the proper court. (Darragh-Fla)
W69-10069

INTERSTATE WATERSHED COOPERATION ACT.

Ark Stat Ann secs 21-1801 thru 21-1806 (1968).

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Descriptors: *Arkansas, *Watershed management, *Water resources development, *Interstate compacts, Interstate commissions, Legislation, Administration, Administrative agencies, Flood control, Water conservation, Water utilization, Water sources, Water supply, Interstate, State governments, Federal government, Water policy, Equitable apportionment, Cost allocation, Cost sharing, Project planning, Cost repayment, Expenses, Damages, Maintenance costs.
Identifiers: Interstate cooperation.

Any watershed improvement district is authorized to cooperate with federal agencies and with other states in interstate watershed projects. These are projects that concern water lying wholly or in part outside the state but which will benefit property in the state and which are authorized by Congress for the prevention of flood water, erosion, and sedimentation damage, as well as conservation, development, utilization and disposal of water. All agreements must contain statements concerning obligations as to installation of works, share of maintenance and costs, share of damages, and share of any excess funds. To fulfill its obligations, any district may appropriate money, issue bonds and levy taxes. (Doublerley-Fla)
W69-10070

POLLUTION OF STREAMS.

For primary bibliographic entry see Field 05G.
W69-10071

FLOOD CONTROL.

Ark Stat Ann secs 9-801 thru 9-811 (1956), as amended, (Supp 1967).

Descriptors: *Arkansas, *Flood control, *Flood routing, *Check structures, Dams, Dikes, Levees, Flood damage, Artificial watercourses, Natural streams, Water control, Flood forecasting, Flood protection, Diversion structures, Legislation, Legal aspects, Reservoirs, Easements, Eminent domain, Administrative agencies, Condemnation.

The Arkansas Soil and Water Conservation Commission is authorized to determine public policy with regard to flood prevention, flood control, and flood protection. The Commission shall compile flood damage figures and collect data relative to recurrence of floods. The Commission is authorized to change the course or terminus of any artificial or natural watercourse; to shape or protect stream banks for better discharge of flood waters; to acquire dam sites; and to construct and operate dams, reservoirs, holding basins, floodgates, or other works designed to control floods. The Commission may construct dikes, levees, or other artificial barriers to protect property from inundations. The Commission may acquire land or easements over land through purchase or condemnation to carry out the purposes of this statute. The Commission, however, may not interfere with the operation of an existing levee or drainage district, and the rights of such districts to make contracts or finance their operations are not impaired. The Commission shall act on behalf of the state in dealing with other states and federal agencies in regard to flood control. The Commission's right of eminent domain is superior to those of railroads, utilities, other corporations, and local governments. (Kelly-Fla)
W69-10072

SALE OF ISLANDS.

Ark Stat Ann secs 10-601 thru 10-609 (1956), as amended, (Supp 1967).

Descriptors: *Arkansas, *Islands, *Boundaries (Property), *Ownership of beds, Legislation, Legal aspects, Navigable waters, Navigable rivers, Streams, Rivers, High water mark, Beds, Alluvium, Surveys, Land forming, Land tenure, Riparian rights.
Identifiers: *Island formation.

All islands formed or which may form in the navigable rivers or streams of the state, subsequent to the state's admission to the Union, are declared to be the property of the state. Provision is made for the sale of such islands by the state. Such sale shall not carry title to any area which separates such island from the mainland or other islands when the separating area is below the line of ordinary highwater, as ordinarily defined by the line of timber growth. In all such cases the title of the purchaser, as the title of all other riparian owners, shall extend only to the line of ordinary highwater. All prior sales of islands in navigable rivers or streams by the state are confirmed, but in such cases the title to beds or channels below the line of ordinary highwater is reserved in the state. (Keith-Fla)
W69-10073

REMOVAL OF SAND AND GRAVEL FROM NAVIGABLE WATERS; AND SALE OR LEASE OF MINERALS ON STATE LANDS.

Ark Stat Ann secs 10-1005 thru 10-1007 (1956); secs 10-1001, 10-1009 thru 10-1013 (Supp 1967).

Descriptors: *Arkansas, *Minerology, *Sands, *Gravels, Legislation, Legal aspects, Construction materials, Road construction, Navigable waters, Beds, Ownership of beds, Navigable rivers, Royalties, Permits, Navigation, Transportation, Fishing, Recreation, Surveys, Beds under water, State governments, Administrative agencies, Lake beds, Compensation.

Sand and gravel may be removed from the beds or bars of any navigable river or lake by any federal or state agency for the purpose of road construction or maintenance without payment to the state for same. Any entity other than the foregoing which removes sand or gravel for commercial gain in connection with road construction or maintenance will pay royalties to the state for same. All such entities must keep accounts of the amount of sand and gravel so removed. Sand and gravel removed for purposes other than the foregoing will not be charged for if records are kept of its removal. It is unlawful to take sand, gravel or other minerals from the beds or bars of navigable rivers and lakes without the consent of the Commissioner of Revenues. The leasing of mineral rights in state owned land is specifically provided for. The state will not acquire title to minerals in and under lands covered by navigable waters artificially created by the state or federal government unless compensation is paid therefor. The exercise of mineral rights will be subservient to the public use of navigable waters for navigation, transportation, fishing and recreation. (Keith-Fla)
W69-10074

PACKET AND NAVIGATION COMPANIES—COAL AND STONE COMPANIES.

Ark Stat Ann secs 35-701 thru 35-710 (1962).

Descriptors: *Arkansas, *Eminent domain, *Right-of-way, *Navigable waters, Legislation, Condemnation, Legal aspects, Water rights, Non-consumptive use, Water utilization, Navigable rivers, Streams, Harbors, Transportation, Boats, Ships, Navigation, Access routes, Land appraisal, On-site investigations, Real property, Railroads, Bayous.

Packet companies that run boats as common carriers have the right of eminent domain to establish landings on streams and the right to make harbours by deepening and widening creeks and bayous emptying thereto up to three miles from their mouths. All steamboats have the right to land, load, and unload at such places. Packet, stone, and coal companies have the right of eminent domain to construct roads to the loading places. Navigation companies that transport freight or passengers may obtain the right-of-way to connect navigable bodies of water by railroad. Rights-of-way may be obtained by petition to the county court. The court appoints a jury to value the land over which the

right of way runs. That amount is to be paid to the owners, and the land is vested in the petitioner. (Doublerley-Fla)
W69-10075

LEVEE AND DRAINAGE DISTRICTS.

Ark Stat Ann secs 35-1101 thru 35-1113 (1962).

Descriptors: *Arkansas, *Right-of-way, *Appraisals, *Adjudication procedure, Drainage districts, Legislation, Ditches, Drainage, Excavation, Water conveyance, Condemnation, Condemnation value, Eminent domain, Easements, Evaluation, Land appraisal, On-site investigations, Federal government, Administrative agencies, Appropriation, Relative rights, Water storage, Flow, Real property, Levees.

Levee and drainage districts are authorized to take land and rights-of-way by agreement, purchase or otherwise for levees, drains, canals or ditches. Where it is necessary to condemn rights-of-way, the circuit court appoints three disinterested appraisers for one-year terms to assess damages to and the value of appropriated lands. Where property is appropriated, districts petition the circuit court to have the appraisers make an award to owners. If no exceptions are filed after notice to owners, judgment is made for condemnation; otherwise the case is docketed for trial. Districts may refuse to pay the award or judgment and relocate without liability. Provisions are made for appraisers' fees and court costs. Owners may have a cause of action if land or rights-of-way are appropriated without consent or without procuring the legal rights, although a one-year statute of limitations is imposed. Districts may also acquire flowage and storage rights by agreement with owners or by condemnation. The purpose of the act is to take advantage of federal grants while using existing districts and tax structures. (Doublerley-Fla)
W69-10076

NAVIGABLE WATERCOURSES AS FENCES.

Ark Stat Ann secs 78-1344, 78-1353 (1958).

Descriptors: *Arkansas, *Boundaries (Property), *Navigable rivers, *Watercourses (Legal), Legal aspects, Legislation, Rivers, Streams, Banks, Water gaps, Navigable waters.

Identifiers: *Fences, Fencing districts.

Where the boundary of any fencing district is a navigable river, such river is deemed to be a good and lawful fence as part of the fence enclosing the remainder of the district. Where the boundary of any fencing district lies along the bank of a navigable stream and another watercourse flows into such stream across such boundary with sufficient force to render watergaps impracticable, the distance from bank to bank of such watercourse is deemed to be a good and lawful fence as part of the fence enclosing the fencing district. (Keith-Fla)
W69-10077

CROSSING OF STREAMS BY RAILROADS.

Ind Ann Stat sec 36-1701 (1949).

Descriptors: *Indiana, *Railroads, *Watercourses (Legal), *Transportation, Legislation, Highways, Streams, Maintenance, Embankments, Grading, Canals.

Identifiers: *Crossings.

Every railroad company shall have the right to construct its railroad across any stream, watercourse, road, highway, railroad or canal which intersects with its route. Such railroad corporation shall restore and maintain the stream or watercourse, road, or canal in its former state, or in a sufficient manner so as to not unnecessarily impair its usefulness or injure its operations. (Heckerling-Fla)
W69-10175

DRAINS, CULVERTS, AND BRIDGES AS PART OF THE STATE HIGHWAY.
For primary bibliographic entry see Field 04A.
W69-10179

PARK DISTRICTS ABUTTING PUBLIC WATERS.

Ill Ann Stat ch 105, secs 11-1 thru 11-5 (Smith-Hurd 1952).

Descriptors: *Illinois, *Parks, *Reclamation, *Navigable waters, Legislation, Public benefits, Beds under water, Land tenure, State governments, Access routes, Operation and maintenance, Construction, Navigation, Damages, Bodies of water, Control, Breakwaters, Ownership of beds, Compensation.

When any park district borders upon any navigable body of water, the title to the bed or submerged land being vested in the state, said district may take possession of, enclose, fill in, reclaim, and protect any portion of such submerged land bordering thereon over which navigation is not practical. Such park district shall also have the power to construct and maintain parks over such land, and title shall then vest in such district to be held for the use and benefit of the public. The district may construct break-waters for the protection of such parks. The district shall not grant or cede away any submerged lands so reclaimed. If such park construction shuts off any property not belonging to the district from access to the water, the district shall pay all damages arising therefrom. Whenever any park district is located along any navigable body of water, the corporate authorities may control and police such body of water. The district shall have no right to interfere with navigation on any navigable body of water or to shut off the access to any public dock or landing thereon or to shut off the access of public highways to such body of water. (Heckerling-Fla)

W69-10183

EMINENT DOMAIN.

For primary bibliographic entry see Field 04A.
W69-10185

ACQUISITION OF SUBMERGED LANDS FOR PUBLIC PARK PURPOSES.

Ill Ann Stat ch 105, secs 81, 83, 84, 92, 94 (Smith-Hurd 1952).

Descriptors: *Illinois, *Parks, *Local governments, Beds, Lakes, Lake Michigan, Riparian rights, Construction, Financing, Reclamation, Shorelines, Bridges, Navigation, Tunnels.

Whenever the commissioners of Lincoln Park shall decide to make an extension over and upon submerged lands under Lake Michigan, it shall file the plan with the Secretary of State for approval. The submerged lands thus acquired, the shore lands and riparian rights appurtenant thereto shall be used to create public park facilities. The costs of acquisition, reclamation, and construction will be paid by the commissioners from general revenue or interest bearing bonds. Every board of park commissioners may extend any park or boulevard over and upon the bed of public waters or may connect any two parks under the same board by constructing a boulevard extending upon submerged land. The commissioners may also construct viaducts, bridges, and tunnels if such are essential to said extension or connection. Land may be acquired by purchase or condemnation. The new boundary lines and dividing lines will be established by the proper suit in chancery. (Darragh-Fla)

W69-10186

STATE GOVERNMENT: A FORCE IN WATER DEVELOPMENT,
Colorado Univ., Boulder.
Leonard B. Dworsky.

IN Water: Development, Utilization, Construction, 5th Western Resources Conference, Boulder, Colo., p 139-148, 1963.

Descriptors: *Water resource development, *State jurisdiction, State administrative agencies, Statutes, Municipal water, Federal-state water rights conflicts.

Two considerations of the role of state governments in water resources development are investigated: (1) a comparison of the position of the states and the federal governments and the role of the states in regard to municipal water supply; and (2) the principles to guide formulation of state water resource development programs. Approximately 200 state agencies are responsible for various aspects of water resources development and management; 54 are identified as primary water resource agencies. Their combined annual budget approaches \$79 million; however, four of these states (California, Louisiana, Massachusetts and Illinois) account for almost \$65 million. State support for research is virtually non-existent. The contrast with the federal government is marked in that respect since the research efforts of the federal water resource agencies represents the bulk of the nation's expenditures for this activity. In regard to the state's role in municipal water supply, they play a fundamental one. States create the local governmental entity, authorize it to construct, operate and to maintain water systems, and to tax, apply charges and issue bonds or other securities. State agencies protect public health and public investment through review and approval procedures. The article contends that, therefore, the state stands in a pivotal position and should have strong state programs as an essential middle line between the federal and municipal function. The principles that states should adopt are: (1) a statutory state-wide policy; (2) vesting of responsibility for over-all water resources planning in a single state agency; (3) formulation of a state water plan; (4) provision to construct, operate and maintain water resource development prospects and provide financial assistance; and (5) board statutory powers to resolve conflicts. (Starr-Chicago)

W69-10193

POLITICS AND LAND USE: THE INDIANA SHORELINE OF LAKE MICHIGAN,

Chicago Univ., Ill.

Harold M. Mayer.

Annals of the Association of American Geographers, Vol 54, No 4, Dec 1964. p 508-523, 3 fig, 19 ref.

Descriptors: *Land use, *Political aspects, Lake Michigan, Indiana, Industries, *Recreation demand, Harbors, Inter-agency cooperation, Conservation, Dunes, Illinois.

Identifiers: Conflicting use, Burns Ditch, Illiana harbor proposal, Regional planning.

The article discusses the conflict for use of land on the Indiana shoreline between urban-industrial interests and recreation-conservation interests. It describes the expansion of steel mills and their need for harbors, the struggle for federal harbor development in Burns Ditch, alternative sites to Burns Ditch for major port and industrial development, the Illiana interstate 'tri-cities' harbor proposal, and conservation and recreation in the dunes area. The conflict for land on Lake Michigan illustrates the difficulties resulting when a geographical entity occupies portions of several political units, and demonstrates the potential value of comprehensive metropolitan and regional planning. Four decades of delay on the proposal for an interstate harbor illustrate the difficulties of rationally developing facilities of benefit to both Illinois and Indiana. The complexity of these issues is producing a condition in which political pressures do not constitute the effective mechanism needed to achieve the optimal solution. Objective consideration of regional problems by qualified social scientists, working through local, regional, and state planning agencies, is recommended. (Gossen-Chicago)

W69-10199

STATE REGULATION OF CHANNEL ENCROACHMENTS,
Edward W. Beuchert.
Natural Resources Journal, Vol 4, No 3, p 486-521, Jan 1965. Abt 125 ref.

Descriptors: Legislation, Flood control, Non-structural alternatives, Floodways, State governments, Channel improvement.

Identifiers: *Channel encroachment, *Model Act, Floodway-encroachment lines, Department of Water Resources.

The article focuses on channel encroachment legislation, which attempts to maintain an adequate channel for flood waters by preventing any flow-constricting development in the channel. The article analyzes existing legislation and proposes a Model Act. The proposed act is meant to be part of a greater plan of water regulation and not an isolated enactment for which a new agency must be set up. The act declares that floodway-encroachment lines be established along watercourses and drainways and establishes, as a part of the Department of Water Resources, a program to delineate Department Floodways from Statutory Floodways. The Department will collect flood data, legislate encroachment lines, and alter lines as necessary. Additional sections of the Model Act cover: nuisances; unlawful acts; permits; power to remove obstruction; the Department's right of entry on lands and waters; power of making investigations; exception for certain watercourses and drainways; penalties; orders and rules of the Department; remedies; and severability. (Gossen-Chicago)

W69-10207

THE ECONOMICS OF WATER TRANSFER,
California Univ., Berkeley. Giannini Foundation.
For primary bibliographic entry see Field 06B.

W69-10208

THE COLUMBIA RIVER TREATY AND PROTOCOL AGREEMENT,

W. R. Derrick Sewell.

Natural Resources Journal, Vol 4, No 2, p 309-331, Oct 1964. 2 fig, 2 tab, 42 ref.

Descriptors: *International waters, History, International Joint Commission, Water distribution (Applied), Optimization, United States, Columbia River, Negotiations.

Identifiers: *Columbia River Treaty, *Protocol Agreement, *Unified basin development, Downstream, Benefits, Canada, British Columbia, Ottawa.

There are three broad types of international river development: unilateral, exclusive and unified. There are no examples of unified development of international rivers. The Columbia River offered possibilities of unified basin development but the Columbia River Treaty falls short of that ideal. Section I discusses origins of the Treaty, focusing on International Joint Commission investigations, debates over Canada's right to downstream benefits, and a method for determining the magnitude of downstream benefits and for allocating benefits. Section II describes the Treaty. Section III discusses British Columbia-Ottawa relations, focusing on the proposed agreement between British Columbia and the Kaiser Aluminum Company, disagreement over the sale of downstream benefits, expropriation of the British Columbia Electric Company, and the British Columbia-Canada agreement. Section IV describes the Protocol Agreement, which removed some objections raised in Canada about the original Treaty. Section V documents opposition to the Treaty, focusing on the proposed McNaughton Plan, the High Arrow Project, and flood control payments. The article concludes that, although optimum use of the River will not be achieved, the Treaty benefits both countries by facilitating development of a resource which

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

would have remained undeveloped. (Gossen-Chicago)
W69-10209

DETERMINING WATER REQUIREMENTS FOR SETTLING WATER DISPUTES,
For primary bibliographic entry see Field 06D.
W69-10211

ARIZONA v. CALIFORNIA -- A BRIEF REVIEW,
Rutgers - The State Univ., New Brunswick, N.J.
David Haber.
Natural Resources Journal, Vol 4, No 1, p 17-28,
May 1964. 41 ref.

Descriptors: *Judicial decisions, Water allocation (Policy), Interstate rivers, Colorado River, California, Arizona, Navigable waters, Water distribution (Applied), Contracts, Legislation, Federal jurisdictions, Administrative agencies, Water resources development, Cost allocation.

The U.S. Supreme Court ruled on the struggle between California and Arizona for Colorado River water. Its decision recognized for the first time the power of Congress to control apportionment; and its language suggested that the power can be extended to non-navigable streams. Second, the opinion holds that the Secretary of the Interior has the power to allocate water within a state through contracts without regard to the state's water allocation laws and under very broad standards established by federal law. Policy accomplishments of the decision are as follows: (1) The allocation problem was transferred from the Court to the political and administrative arenas; (2) The great power given to the federal government has created the leverage to force states to make agreements; (3) These powers make it possible to accomplish a fully integrated development-allocation scheme without interference of conflicting state authority; and (4) No undue share of the cost will be placed on individual users for the benefit of the entire community or of other users. There are ambiguities in the decision; but it offers Congress the opportunity to integrate water development and use control of the entire region. (Gossen-Chicago)
W69-10212

THE INTERSTATE COMPACT--A FORM OF CREATIVE FEDERALISM,
For primary bibliographic entry see Field 06B.
W69-10214

WATER RECREATION - PUBLIC USE OF 'PRIVATE' WATERS,
For primary bibliographic entry see Field 06B.
W69-10215

WATER RIGHTS LAW IN IOWA,
For primary bibliographic entry see Field 06C.
W69-10216

TRENDS IN WATER RIGHTS LEGISLATION.
For primary bibliographic entry see Field 06B.
W69-10217

LAKE MICHIGAN RIGHTS OF RIPARIAN OWNERS.
Ind Ann Stat secs 62-701 thru 62-703 (1962).

Descriptors: *Indiana, *Lake Michigan, *Riparian rights, Reclamation, Parks, Beds, Lake beds, Landfills, Harbors, Docks, Great Lakes, Great Lakes region, Navigable waters, Recreation, Easements, Land development, Patents, Surveys, Land tenure, Land reclamation, Legal aspects, Riparian land. Identifiers: Abutting land owners.

Land owners or the owners of any easement for public park purposes in, over, or through any land

bordering on the waters of Lake Michigan have the right to reclaim submerged lands adjacent to their lands. Submerged lands between the shore and the dock or harbor line established by the United States may be reclaimed. A patent from the state shall issue to the owners of reclaimed land upon payment of a certain fee per acre. The reclaimed land may be used for commercial, manufacturing, recreational, and public purposes. (McDonough-Fla)
W69-10218

SWAMP, SALINE, AND MEANDER LANDS OF STATE-PURCHASE FOR PUBLIC PARK OR FOREST PURPOSES.

Ind Ann Stat sec 62-217 (1962).

Descriptors: *Indiana, *Public lands, *Land use, *Land development, Legislation, Parks, Recreation facilities, Forests, Saline soils, Swamps, Bogs, Salt marshes, Fresh water marshes, Meanders, Streams, Banks, Legal aspects.

State owned swamp, saline, and meander lands bordering on lakes and streams may be purchased for public park and forest purposes by natural persons, corporations, associations and municipalities or by any combination thereof. (McDonough-Fla)
W69-10219

WATER RIGHTS POLICIES IN THE SOUTHEAST,
For primary bibliographic entry see Field 06B.
W69-10220

WATER RIGHTS AND ADMINISTRATION WITH RESPECT TO SOIL AND WATER CONSERVATION,
C. E. Busby.

Agric Engin, Vol 34, No 11, p 769-770, 772, 774, 776, 778, 780, Nov 1953. 7 p, 18 ref.

Descriptors: *Water rights, *Soil conservation, *Water conservation, *Administration, Legal aspects, Regions, Adoption of practices, Water resources, Land use, Water utilization, Engineering, Damages, Flood damage, Erosion, State governments, Local governments, Surface waters, Groundwater, Watercourses (Legal).

Water problems which have legal and administrative implications arise out of an over-abundance or a shortage of water. Rapid increases in the rate of water use since World War II have been accompanied by droughts, continuing pollution of streams, and lack of sufficient storage capacity which have created acute problems, particularly in the seaboard states. The soil conservation movement has also grown during this period, and its areas of concern are interdependent upon the problems of water usage and water damage which affect land use. The farmers engaged in soil conservation projects should give consideration to the legal and administrative facets of related water problems and should cooperate with other groups in improving water laws and administrative systems. Improvements in water law and administration should include: (1) legislative control over artificial rainmaking; (2) study and legislation regarding management and use of diffused surface waters; and (3) conservation measures for streams, lake waters, and ground waters. A progressive trend in western states to create systems of water rights better adapted to problems of expanding economy and of orderly development and conservation should be followed in the East. (Kelly-Fla)
W69-10221

DEPOSIT OF SAWMILL WASTE IN WATERS.
For primary bibliographic entry see Field 05G.
W69-10222

ERCTION AND INSPECTION OF DAMS.
For primary bibliographic entry see Field 04A.
W69-10228

W69-10223

CONNECTICUT RIVER FLOOD CONTROL COMPACT.
For primary bibliographic entry see Field 04A.
W69-10224

DRAINAGE OF LOW LANDS.
For primary bibliographic entry see Field 04A.
W69-10225

RUBIN V W. H. HINMAN, INC. (STATE DRAINAGE EASEMENTS).
For primary bibliographic entry see Field 04A.
W69-10226

FISH.

Ill Ann Stat ch 56, secs 141-159 (Smith-Hurd 1967), as amended, (Supp 1969).

Descriptors: *Illinois, *Fish, *Administrative agencies, *Conservation, State governments, Pollution, Fish stocking, Schools, Legislation, Fish management, Fish harvest, Investigations, Fish conservation, Planning.

The 'fish code of Illinois' is to be administered by the Department of Conservation. Fishing seasons and limits established by this department are designed to preserve the biological balance. The department shall also conduct pollution investigations, plan for propagation and stocking of fish, frogs, and mussels, including the production of eggs in cooperative units for stocking. The Department shall take all steps necessary to further the cause of fish conservation including bringing actions for violations of fish regulations. Training schools shall be established to instruct in the science of conservation. Both conservation employees and regular police officers may enforce provisions of this act. Violations are tried in the circuit court. These officers may search and confiscate all fish and devices or contraband involved in these illegal activities. Each such fish, minnow, frog, mussel, or part thereof illegally taken shall constitute a separate offense, and all fines, fees, and income collected by the department shall go into the game and fish fund. (Darragh-Fla)
W69-10227

DEPARTMENT OF NATURAL RESOURCES.
Ky Rev Stat Ann secs 146.010 - 146.120 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Natural resources, *Water conservation, *Soil conservation, Legislation, Legal aspects, Flood control, Water utilization, Industrial water, Strip mines, Conservation, Administrative agencies, Forestry, Watershed management, Drainage, Reclamation, Water resources, Resources.

The Department of Natural Resources is responsible for: (1) the conservation of natural resources, except wildlife; (2) flood control and water usage; and (3) strip mining and reclamation. There is provision for organization and administration of the Department. Conservation and maintenance of state controlled forests are provided for. A Division of Soil and Water Conservation is created to assist existing soil and water conservation districts and watershed conservancy districts. The Soil and Water Conservation Commission is given the power to take any action it may consider necessary for the purposes of assisting soil and water conservation districts or watershed conservancy districts in carrying out their functions and discharging the state's responsibilities relating to flood control, drainage and other activities with respect to conservation, utilization or control of soil or water resources. (Keith-Fla)
W69-10228

Nonstructural Alternatives—Group 6F

FISH AND WILDLIFE REGULATIONS.

Ky Rev Stat Ann secs 150.110-110.180 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Fish conservation, *Wildlife conservation, *Permits, Legislation, Legal aspects, Mussels, Fish, Wildlife, Regulation, Streams, Administrative agencies, Bodies of water, Fishing, Sport fishing.
Identifiers: Penalties (Criminal).

Conservation officers may arrest anyone violating any of the regulations made for the protection of mussels, fish, or wildlife. Fines collected for violation of wildlife regulations are paid into the game and fish fund. Such funds may only be used to carry out the purposes of the chapter for the protection of wildlife. Licensing requirements for the taking of wildlife are specifically enumerated. Mussels and fish other than sport fish may be bought, sold, and transported when in legal possession. Otherwise the purchase, sale, and transportation of wildlife is largely prohibited. (Keith-Fla)
W69-10229

OPERATION OF WATERCRAFT.

Ind Ann Stat secs 68-813 thru 68-871 (1961), as amended, (Supp 1968).

Descriptors: *Indiana, *Boating regulations, *Boats, *Recreation, Navigation, Safety, Inspection, Bodies of water, Lakes, Lake Michigan, Great Lakes, Legal aspects, Right-of-way, Legislation, Water sports, Equipment.
Identifiers: Penalties (Civil).

The operation of watercraft on Indiana public waters for commercial and recreational purposes is regulated by various safety and operational provisions. These provisions include the designation of the types of equipment required on watercraft, who may operate watercraft, and the rules of boating safety. Violations of this chapter are a misdemeanor. (McDonough-Fla)
W69-10230

GAME AND FISH REFUGES.

Ark Stat Ann secs 47-701 thru 47-708 (1964).

Descriptors: *Administrative agencies, Wildlife management, Fish management, Wildlife conservation, Fish conservation, Land classification, Damages, Assessments, Appraisals, Local governments, State governments, Legislation.

When an owner of 640 acres of land or more desires the land to be set aside as a refuge, he may petition the State Game and Fish Commission. The owner must be willing to vest the state with title to the land. If the Commission is satisfied that the lands are suitable they may establish a refuge and post notices to this effect. The commission may acquire lands for this purpose by gift or purchase and formulate rules for preservation of wildlife. The Commission may acquire watered areas and adjacent lands to be used as fish refuges. The governor may also set aside state lands to be used as refuges and such lands may not later be reclaimed or disposed of by the state. (Darragh-Fla)
W69-10231

DOCKS.

For primary bibliographic entry see Field 04A.
W69-10232

LEVEE AND DRAINAGE DISTRICTS.

For primary bibliographic entry see Field 04A.
W69-10233

REGIONAL WATER DISTRIBUTION DISTRICT ACT.

For primary bibliographic entry see Field 04A.

W69-10234

WHITE RIVER NAVIGATION DISTRICT COMMISSION.

For primary bibliographic entry see Field 04A.
W69-10235

ARKANSAS WATERWAYS COMMISSION.

For primary bibliographic entry see Field 04A.
W69-10236

BRADSHAW V STATE HIGHWAY COMM'R (REQUIREMENT OF LANDOWNERS TO MITIGATE CONDEMNATION DAMAGES).

For primary bibliographic entry see Field 04C.
W69-10237

WINYAH BAY TO SOUTH, ASHLEY RIVER AND SHIPYARD RIVER.

For primary bibliographic entry see Field 04A.
W69-10238

DAVIS V CAHOON (DIVERSION OF NATURAL FLOW BY LOWER LANDOWNER PROHIBITED).

For primary bibliographic entry see Field 04A.
W69-10239

BLOOM V WATER RESOURCES COMMISSION (RELATIVE RIGHTS OF OWNERS OF ADJACENT UPLANDS).

For primary bibliographic entry see Field 04A.
W69-10240

SKAFF V SIOUX CITY (UNREASONABLE DELAY IN CONDEMNATION PROCEEDINGS).

For primary bibliographic entry see Field 04A.
W69-10241

REUTER V DEPT OF NATURAL RESOURCES (ADMINISTRATIVE FINDING OF EFFECTS UPON WATER POLLUTION AS PREREQUISITE TO ISSUANCE OF DREDGING PERMITS).

For primary bibliographic entry see Field 05G.
W69-10242

DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.

For primary bibliographic entry see Field 04A.
W69-10243

DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.

For primary bibliographic entry see Field 04A.
W69-10244

DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.

For primary bibliographic entry see Field 04A.
W69-10245

WATER SUPPLY.

For primary bibliographic entry see Field 05G.
W69-10246

GREAT LAKES RIVER BASINS COMMISSION.

For primary bibliographic entry see Field 06B.
W69-10247

POWER TO ACQUIRE PIERS AND BEACHES.

For primary bibliographic entry see Field 04A.
W69-10248

RAILROAD COMPANY MAY OPERATE FERRY.

Ky Rev Stat Ann sec 277.090 (1963).

Descriptors: *Kentucky, *Railroads, *Transportation, *Boats, Legislation, Operation and maintenance, Streams, Boundaries (Surfaces), Legal aspects.

Identifiers: *Ferries.

Any railroad company may, without securing the grant of any ferry franchise or privilege from the county court, transport or employ other persons to transport for it, any passengers, baggage, or freight carried on its railroad line across any stream within or bordering upon this state. Any railroad operating a ferry for the above purposes may not operate the ferry within a mile and a half of any ferry already in operation. (Heckerling-Florida)
W69-10249

STATE AID IN FLOOD CONTROL; MUNICIPAL-FEDERAL FLOOD CONTROL PROJECTS.

For primary bibliographic entry see Field 04A.
W69-10250

LOCATING SOURCE OF WATER SUPPLY OUTSIDE OF MUNICIPALITIES.

For primary bibliographic entry see Field 04A.
W69-10251

TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT.

For primary bibliographic entry see Field 05G.
W69-10296

INTERSTATE WATER SANITATION BOARD.

For primary bibliographic entry see Field 05G.
W69-10297

GROUND WATER CONSERVATION.

For primary bibliographic entry see Field 04B.
W69-10298

STREAM CAVING AND ROAD CONSTRUCTION.

For primary bibliographic entry see Field 04C.
W69-10299

SANITARY PROVISIONS.

For primary bibliographic entry see Field 05F.
W69-10300

6F. Nonstructural Alternatives**THE FLOODPLAIN AND THE SEASHORE: A COMPARATIVE ANALYSIS OF HAZARD-ZONE OCCUPANCE.**

Ian Burton, and Robert W. Kates. Geographical Review, p 366-385, July 1964. 11 fig, 31 ref.

Descriptors: Non-structural alternatives, Flood plain zoning, Coastal plains, River basins, Flood control, Flood protection, Engineering structures, Federal project policy, Hydrologic aspects, Engineering.

Identifiers: *Hazard-zone occupance, *Research needs, Geomorphic aspects.

The United States is in danger of implementing a costly program of coastal defense against storms comparable with flood control programs for rivers, which have depended exclusively on engineering works, to the neglect of possible alternatives. Despite federal expenditures of about five billion dollars average annual flood damages from rivers have continued to rise. It is feared that a program to 'contain' the sea would suffer similar results. One adjustment to storm hazards that requires at-

Field 06—WATER RESOURCES PLANNING

Group 6F—Nonstructural Alternatives

tention is zoning. For careful guidance in the human occupancy of hazardous areas, the article recommends research on the rate and process of settlement of these areas. To establish rates of encroachment, the areas of hazard must be defined. The most satisfactory definition would be based on the factors determining the height of surge in recorded storms. To understand the processes of development, the attitudes and perceptions of coastal developers, businessmen and residents must be studied. In order to establish a body of concepts dealing with development processes and possible adjustments in areas of high hazard, the article compares floodplains and coastal areas from three perspectives: (1) hydrologic features; (2) geomorphic factors; and (3) the role of engineering. (Gossen-Chicago)

W69-10204

6G. Ecologic Impact of Water Development

GEOLGY FOR PLANNING IN MCHENRY COUNTY,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 06B.
W69-09912

RESERVOIR LOCATION FOR URBAN RECREATION,
Purdue Univ., West Lafayette, Ind.
For primary bibliographic entry see Field 04C.
W69-10022

EFFECTS OF SURFACE MINING ON THE FISH AND WILDLIFE RESOURCES OF THE UNITED STATES,
Bureau of Sport Fisheries and Wildlife, Washington, D.C.
For primary bibliographic entry see Field 05C.
W69-10137

A FRAMEWORK FOR DEALING WITH THE URBAN ENVIRONMENT: IN TRODUCTORY STATEMENT,
Resources for the Future, Inc., Washington, D.C.
For primary bibliographic entry see Field 06B.
W69-10206

07. RESOURCES DATA

7A. Network Design

FLOW MEASURING STRUCTURES IN THE HYDROLOGICAL OBSERVATION NETWORK,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 02E.
W69-09929

SUMMARY OF HYDROLOGIC AND PHYSICAL PROPERTIES OF ROCK AND SOIL MATERIALS, AS ANALYZED BY THE HYDROLOGIC LABORATORY OF THE U.S. GEOLOGICAL SURVEY, 1948-60,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W69-10143

COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
Wyoming State Engineer's Office, Cheyenne.
William N. Embree, and Lee W. Larson.
State Water Plan Report No 1, Water Resources Series No 13, Sept 1968. 66 p, 2 fig, 3 append.

Descriptors: Annual discharge, Automation, Computer programs, Data processing, Data storage and retrieval, Duration curves, Frequency

analysis, Hydrologic data, Information retrieval, Maximum flow, Mean daily flow, Minimum flow, Streamflow, Surface waters, Water resources, Water year.

A general description of a computerized system for Wyoming Surface Water Records is given. This system, developed by the University of Wyoming's Water Resources Research Institute, in conjunction with the Computer Center, is designed to store and utilize streamflow data. All available programs and types of output are described and procedures for operation of the system are given.

W69-10213

7B. Data Acquisition

UNSTEADY CIRCULATION IN SHALLOW LAKES,
Cornell Univ., Ithaca, N.Y.
For primary bibliographic entry see Field 02H.
W69-09886

PROCESSING OF DIGITAL DATA LOGGER STD TAPES AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AND THE BUREAU OF COMMERCIAL FISHERIES, LA JOLLA, CALIFORNIA,
Bureau of Commercial Fisheries, La Jolla, Calif. Fish-Oceanographic Center.
For primary bibliographic entry see Field 07C.
W69-09894

RECORDED OBSERVATIONS ON THE INFLUENCE OF CLOUDINESS AND WIND VELOCITY ON THE BRIGHTNESS OF THE DAYLIGHT SKY ABOVE THE WATER SPACE (RUSSIAN),
For primary bibliographic entry see Field 02B.
W69-09899

MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH),
Department of Agronomical Sciences of the State, Gembloux (Belgium).

A. Bentz.
La Trib du Cebedeau, Vol 22, No 305, p 186-190, Apr 1969. 5 p, 6 fig, 1 tab, 5 ref.

Descriptors: Nuclear moisture meters, Water properties, Gamma rays, Hydraulic properties, Hydraulic gradient, Hydraulic engineering, Radioisotopes, Soil density, Neutron activation analysis, Diffusion, Absorption, Mathematical studies, Drainage, Instrumentation, Temperature, Geology, Sands.
Identifiers: Gamma-ray soil moisture meters.

The principles, applications, and results of the application of a gamma-ray method for the study of hydraulic profiles of very thin water-bearing beds are described. The discussion includes (1) analytical principle of the method; (2) apparatus; (3) the utilization of the apparatus (determination of absorption coefficients, the use of soil columns); and (4) examples of the method application. The gamma-ray method is a reliable tool for the evaluation of hydraulic profiles of thin soils. (Gabriel-USGS)

W69-09904

DISCHARGE MEASUREMENT IN OPEN CHANNELS BY DILUTION METHODS (FRENCH),
Liege Univ. (Belgium).
Alb Schlag.
La Trib du Cebedeau, Vol 22, No 305, p 196-198, Apr 1969. 3 p, 7 fig.

Descriptors: Discharge (Water), Discharge measurement, Tracers, Solutes, Hydraulic properties, Open channel flow, Water supply, Solvents, Salinity, Injection, Mathematical studies.
Identifiers: Discharge measurement by dilution.

The use of dilution methods to measure water discharges in open canals is described. For that purpose a definite volume of concentrated solution is injected upstream and a water sample taken downstream is analyzed for the salt content. The concentrations can be measured by volumetric chemical analysis, by colorimetric analysis and by electrical conductivity. The application of the dilution method to measure discharges in open conduits was found to be of value. (Gabriel-USGS) W69-09905

MICROWAVE RADIOMETRIC SENSING OF SOIL MOISTURE CONTENT,

Aerojet-General Corp., El Monte, Calif. Space Div. J. M. Kennedy, and A. T. Edgerton.
Symp on Geochem, Precipitation, Evaporation, Soil-Moisture, Hydrom, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Publ No 78, p 418-429, 1968. 12 p, 11 fig, 1 tab.

Descriptors: Soil moisture meters, Microwaves, Remote sensing, Aircraft, Electromagnetic waves, Instrumentation, Measurement, Radar.

Identifiers: Microwave soil moisture meters.

A field measurements program was conducted to determine the response of microwave radiometers to soil moisture content. Materials investigated include beach sand, unconsolidated tideland mud, playa sediments, and loam. Dual polarization measurement were made at frequencies of 13.5 GHz and 37 GHz with aspect angles from nadir to horizontal. The intensity of thermal radiation depends on the temperature and emissivity of the object and on the frequency of observation. Soil total emitted energy can be separated into the emitted energy and the reflected energy. Emitted energy is the product of soil temperature and soil emissivity. Reflected energy is the product of microwave sky temperature and material reflectivity. The dielectric properties of soils are strongly dependent on soil moisture content. Changes in the dielectric constant result in major changes in the emissivity and radiometric brightness temperature. Microwave temperature differences between saturated tidal mud and ocean water covering the mud were found to be about 20 deg K. Soils and sediments containing 1 to 7% water were found to be 120 deg K warmer than the saturated muds. The radiometric temperature difference between playa sediments containing 12 and 30% moisture content was found to be 60 deg K. Polarization effects also changed drastically depending on the viewing angle at which measurements were made. These measurements demonstrate that microwave radiometric surveys can aid hydrologists in many investigations, particularly for airborne applications of hydrological studies of large tracts of land. (Knapp-USGS)

W69-09916

DETERMINATION OF THE SEASONAL AND MONTHLY EVAPORATION NORMALS FROM AGRICULTURAL FIELDS FROM OBSERVATIONS AT A NETWORK OF STATIONS,
State Hydrological Inst., Leningrad (USSR).
For primary bibliographic entry see Field 02D.
W69-09921

INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS,
Stanford Univ., Calif. Dept. of Mineral Engineering; and Stanford Univ., Calif. Dept. of Geology. R. J. P. Lyon, and Keenan Lee.
Stanford Univ RSL Tech Rep No 68-1, Oct 15, 1968. 68 p, 25 fig, 1 tab, 83 ref, 2 append. 14-08-0001-11217 (USGS).

Descriptors: Remote sensing, Infrared radiation, Springs, Lakes, California, Nevada, Thermal springs, Cold springs, Saline water, Arid lands, Mixing, Water quality, Discharge (Water), Hydrogeology, Water levels, Groundwater.
Identifiers: Mono Lake (Calif).

An infrared scanning system is being developed to detect, delineate and evaluate discharge of coastal and shoreline springs. A field testing program involves establishing the hydrogeologic parameters of a test site at Mono Lake, California-Nevada and collecting infrared scanner data. Mono Lake is a rapidly desiccating saline lake in a closed desert basin. The salinity of Mono Lake has increased 50% in the past 20 yr to 76,000 ppm dissolved solids. It is suggested that the lake concentrates natural runoff and groundwaters, modified by addition of thermal spring waters high in Cl and sulfate. Other springs have Ca-bicarbonate waters of low temperature and low total dissolved solids. Two missions were flown at Mono Lake, in October 1967 and June 1968, using the Bendix Thermal Mapper, a line scanner operating in the 0.7 to 5.5 micron region of the infrared. An infrared radiometer (8-14 microns) was used for absolute temperature measurements and was correlated with pertinent ground control measurements. Some multiband photography was taken. Shoreline springs as small as 2 gpm were detected, and all known springs with more than a few gpm discharge can be recognized. Many previously unknown springs were discovered. Unexpected findings on imagery include an apparent surface expression of shallow sublake topography and a secondary plume of colder surface water offshore from warm springs. Spring discharge patterns were delineated by reducing imagery to isothermal maps. (Knapp-USGS)

W69-09932

HEATED THERMOPILE ANEMOMETER COMPARED WITH SENSITIVE CUP ANEMOMETER IN NATURAL AIRFLOW,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Experiment Station.
James D. Bergen.
Rocky Mountain Forest and Range Experiment Station, USDA Forest Service Research Note RM-147, 1969. 4 p, 2 figs, 1 table, 1 ref.

Descriptors: *Instrumentation, *Anemometers, Winds, Velocity, Wind velocity, Meteorology, Air circulation, Equipment.
Identifiers: Errors.

Comparison of twenty 5-minute average speeds showed discrepancies of as much as plus or minus 50 percent with windspeeds ranging from 2.8 to 6.6 miles per hour. The magnitude and sense of the deviations did not vary systematically with turbulence intensity or speed. Measurements were made at an air temperature of about 20 deg C.
W69-09985

EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
Irving Goldberg, Norman A. MacGillivray, and Robert R. Ziener.

Trans Amer Nuclear Soc 10 (1):20-21, 1967.

Descriptors: *Soil moisture, *Soil moisture meters, Soils, Instrumentation, Soil moisture, California, *Nuclear moisture meters, *Meteorology, Nuclear meters.

Identifiers: *Hydrometeorology, Americium-beryllium, Soil moisture measurement.

The effects on soil moisture determination of four different alpha-neutron sources (RaBe, AcBe, PuBe, and AmBe) used in neutron meters were evaluated. (Ziener-Forest Service)

W69-09986

MEASURING MOISTURE NEAR SOIL SURFACE. . .MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.

Robert R. Ziener, Norman A. MacGillivray, and Irving Goldberg.

US Forest Serv Res Note PSW-158, Pacific SW. Forest and Range Exp Sta, Berkeley, Calif, 1967. 6 p, illus.

Descriptors: *Soil moisture, *Nuclear moisture meters, *Soil moisture meters, Soils, Instrumentation, *Meteorology, Nuclear meters, Soil moisture, California.

Identifiers: *Hydrometeorology, Americium-beryllium, Soil moisture measurement.

The variability in surface detection by the four different neutron sources tested may be due to differences in neutron energy or in length of source or in both. (Ziener-Forest Service)

W69-09987

MECHANICS AND RATES OF NATURAL SOIL CREEP,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Eugene Kojan.
Proc Fifth Annual Eng Geol and Soils Eng Symp, Pocatello, Idaho, April 1967. p 233-253.

Descriptors: Creep, *Slope stability, *Shear strength, *Landslides, *Soil strength, Soils, Soil stability, Shear, Soil mechanics, California, Erosion, Soil tests.

Identifiers: Over-consolidated sediments.

Ordinary concepts of effective peak shear strength are not applicable in estimating slope stability where creep is prevalent, especially in soils developing on the rapidly eroding, highly over-consolidated sediments of the Coast Ranges.

W69-09988

LEACHABILITY OF A WETTING-AGENT TREATMENT FOR WATER-RESISTANT SOILS,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 02G.
W69-09989

INSTRUMENTATION FOR SNOW GAGING -- YESTERDAY, TODAY, AND TOMORROW,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James L. Smith.
Isotope and Radiat Tech 4 (3):227-237, 1967. 10 p.

Descriptors: *Gamma rays, Watershed management, Snowmelt, Snowpacks, *Precipitation gages, Instrumentation, Snow, Rainfall, California.

Identifiers: *Nuclear snow gage, *Snow measurement, Snow density measurement.

Three systems of snow gaging have been used. These consist of gravimetric methods, weighing platforms, and nuclear gages. The development of these systems is described, along with their advantages and disadvantages. (Smith-Forest Service)

W69-09992

SNOW EVAPORATION REDUCTION: MIGRATION OF EVAPORATION SUPPRESSANTS THROUGH SNOW,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Edward H. Essington, and James L. Smith.
Trans American Nuclear Society, 1967. Vol 10, No 1, p 77.

Descriptors: *Snowmelt, *Evaporation control, *Evaporation, Snowpacks, Snow, Tracers, California, Hexadecanol, Monomolecular films.

Identifiers: Snow evaporation suppression.

Movement of evaporation suppressants on and through snowpacks is being studied with use of isotopes. Laboratory studies show tracer to be reliable.

Future research will follow disposition of the tracer applied to snowpacks as snowpacks melt. (Smith-Forest Service)

W69-09993

GAMMA-TRANSMISSION PROFILING RADIOSOLOPE SNOW DENSITY AND DEPTH GAGE,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James L. Smith, and Donald W. Willen.
West Snow Conf Proc, 1966. p 69-77.

Descriptors: *Precipitation gages, *Snow, Snowpacks, *Gamma rays, Watershed management, Snowmelt, California.

Identifiers: *Gamma-transmission system, Rain-on-snow, *Nuclear snow gage.

A gamma-transmission system can measure snow density adequately throughout a snowpack profile. It can be used to determine density increases due to snowmelt or rain on snow, and there is no effect on attenuation by the different forms of water. (Smith-Forest Service)

W69-09994

ISOTOPE SNOW GAGES FOR DETERMINING HYDROLOGIC CHARACTERISTICS OF SNOWPACKS,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James L. Smith, and Donald W. Willen.
IN Isotope Techniques in the Hydrologic Cycle, Amer Geophys Union Geophys Mono 11, 1967. p 11-21, illus.

Descriptors: Hydrology, Watershed management, Snowmelt, *Precipitation gages, Snowpacks, California.

Identifiers: *Snow density.

The isotope snow gage has proved to be superior to any system heretofore used for detection of snow depth, water content, and density. (Smith-Forest Service)

W69-09995

ISOTOPES -- A MULTIPURPOSE TOOL FOR FOREST WATERSHED RESEARCH,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James L. Smith.
Int Symp on Forest Hydrol, Pa State University, Aug 29-Sept 10, 1965, New York, Pergamon Press, 1967. p 771-778

Descriptors: Hydrology, Watershed management, Snowmelt, *Precipitation gages, Instrumentation, Tracers.

Identifiers: Snow density.

A snow gage of new design has been tested which measures snow density in situ in half-inch increments throughout a snowpack. (Smith-Forest Service)

W69-09996

PORTABLE RADIOACTIVE ISOTOPE SNOW GAGES FOR PROFILING SNOWPACKS,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James L. Smith, Donald W. Willen, and Michael S. Owens.

US Atomic Energy Comm, Div Tech Info, TID-23368, 1966. 51 p, illus.

Descriptors: Hydrology, Watershed management, Snowmelt, *Snowpacks, *Precipitation gages, California.

Identifiers: Snow measurement.

Describes portable, battery-operated neutron and gamma scatter gages; gamma transmission gages have been tested for their ability to profile snowpacks. (Smith-Forest Service)

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

W69-09997

A GAMMA-TRANSMISSION GAGE FOR PROFILING SNOWPACK,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James L. Smith, Donald W. Willen, and Michael Owens. US Atomic Energy Comm, Isotope Syst Develop Conf Proc, Washington, D.C. 1965. p 36-37.

Descriptors: Hydrology, Watershed management, Snowmelt, Snowpacks, Precipitation gages, Instrumentation, California, Gamma rays.
Identifiers: Snow measurement, Density profiles.

A gamma-transmission gage for profiling snowpacks has been successfully tested. It is possible to profile a snowpack in one-half inch vertical increments. Snow density measurements are accurate to within 1/2 percent of actual density. (Smith-Forest Ser)
W69-10000

MEASUREMENT OF SNOWPACK PROFILES WITH RADIOACTIVE ISOTOPES,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James L. Smith, Donald W. Willen, and Michael S. Owens. Weatherwise 18 (6), p 246-251, 257, 287, Dec 1965.

Descriptors: Hydrology, Watershed management, Snowmelt, Snowpacks, Instrumentation, California, Gamma rays.
Identifiers: *Snow measurements, Snow density.

A snow gage using cesium-137 as the source and sodium-iodine crystal for detector measured snow density accurately in 1/2-inch vertical increments. With this system a 10-foot snowpack may be profiles in 10 minutes by moving the detector and source through the snowpack at a constant rate. Output was recorded on an analog chart. (Smith-Forest Ser)
W69-10001

IDENTIFICATION OF SPECTRAL CHARACTERISTICS OF HYDROLOGICAL SERIES BY A MODIFICATION OF THE GRENANDER-ROSSENBLATT METHOD (RUSSIAN),
For primary bibliographic entry see Field 02E.
W69-10096

INVESTIGATION OF WATER RESERVOIR BOTTOM DENSITY USING RADIOMETRIC METHODS (POLISH),
For primary bibliographic entry see Field 02J.
W69-10109

DISCHARGE MEASUREMENTS AT GAGING STATIONS,
Geological Survey, Washington, D.C. Thomas J. Buchanan, and William P. Somers. Geol Surv Tech Water-Resources Invest, Book 3, Chapter A8, 1969. 65 p, 73 fig, 8 tab, 15 ref.

Descriptors: *Discharge measurement, *Current meters, *Stream gages, Flowmeters, Discharge (Water), Streamflow, Open channel flow, Flumes, Weirs, Instrumentation, Gaging stations, Equipment, Floats, Hoisting machinery, Operation and maintenance.
Identifiers: *U.S. Geological Survey, Stream gaging handbook.

The techniques used in making discharge measurements at gaging stations are described. Most of the report deals with the current-meter method of measuring discharge, because this is the principal method used in gaging streams. The uses of portable weirs and flumes, floats, and volumetric tanks in measuring discharge are briefly described. The types of current meters, sounding equipment,

stream-width measuring equipment, support equipment, weirs, flumes, floats, gages, and tracer methods used by the U.S. Geological Survey, are described in detail and shown by photographs. (Knapp-USGS)
W69-10111

DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE,
State Hydrological Inst., Leningrad (USSR). Yu. I. Rabinovich, G. G. Shchukin, and V. V. Melej'yev. Transl from Trudy GGO, No 222, 1968, p 49-53. Soviet Hydrol Selec Pap, No 3, p 266-269, 1968. 4 p, 3 fig, 5 ref.

Descriptors: *Remote sensing, *Water temperature, *Microwaves, Electromagnetic waves, Instrumentation, Measurement, Photometry, Radiation, Thermal radiation, Cloud cover.
Identifiers: *Radiometry, Microwave radiometry.

Determination from aircraft of the temperature of the underlying surface from its emission is an important geophysical problem. Investigations of this kind had been conducted for several years in the infrared region of the spectrum in which measurements are strongly distorted by the atmosphere. Measurements in the infrared region are absolutely impossible in the presence of clouds. Use of the microwave region of the spectrum permits information to be obtained on the temperature of the underlying surface through clouds and precipitation, whose influence decrease with increasing wavelength. Large instrumental errors of the microwave measuring equipment can now be substantially reduced by improving the equipment and the method of calibrating it. (Knapp-USGS)
W69-10140

INVESTIGATION OF A METHOD OF MEASURING SNOW STORAGE BY USING THE GAMMA RADIATION OF THE EARTH,
State Hydrological Inst., Leningrad (USSR). For primary bibliographic entry see Field 02C.
W69-10142

A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND,
Marine Lab., Aberdeen (Scotland); and Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
For primary bibliographic entry see Field 02L.
W69-10150

THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHORYLATION, AND MACROMOLECULES IN BENTHIC ALGAL MATS,
Indiana Univ., Bloomington. Dept. of Microbiology.
For primary bibliographic entry see Field 05C.
W69-10151

THE APPLICATION OF MICRO-AUTORADIOGRAPHIC TECHNIQUES TO ECOLOGICAL STUDIES,
Indiana Univ., Bloomington. Dept. of Microbiology.
M. Louise Brock, and Thomas D. Brock.

International Association of Theoretical and Applied Limnology, Communications, No 15, p 1-29, 1968. 6 fig, 2 tab, 38 ref.

Descriptors: *Ecology, *Radioactivity techniques, *Radioisotopes, Limnology, Oceanography, Tracers, Bacteria, Growth rates, Tritium, Photography, Carbon radioisotopes, Phosphorus radioisotopes, Algae, Emulsions, Background radiation, Iodine radioisotopes, Nutrient requirements.

Identifiers: *Micro-autoradiography, Physiology, Biochemical extraction, Millipore filters, Phase microscopy, Staining, Stripping film, Synechococcus, Grain count (Autoradiography), Leucothrix mucor, Antithamnion sarniense, Quantitation, Growth modes.

Authors describe autoradiography in detail, not only as an adjunct to other radioactivity experiments, but as a principal technique in limnology, oceanography, and related environmentally oriented disciplines. Technique can be used as a sole method to study nutrition and physiology in the laboratory as well as in the natural environment. Simple biochemical extraction methods are described. Autoradiographic results obtained from experiments based on such methods illustrate the analysis of autoradiograms and demonstrate the validity of autoradiographic techniques. Detailed information delineates the use of autoradiography in evaluating mode and rate of bacteria growth. Detailed methods for preparation of specimens, handling of liquid autoradiographic emulsion, and development of autoradiograms are given with special emphasis on limnological applications. Comparisons are made with conventional methods for assay of radioactive isotopes. Tritium was the most suitable radioactive isotope for their experiments. Liquid emulsion (NTB-2) and stripping film are compared. Qualitative evaluation can be accomplished with two-exposure photographs by focusing on grains to photograph them at half the total required exposure, then refocusing on cells to photograph them during other half of total required exposure. Relative quantitation and absolute quantitation are discussed. (Jones-Wisc)
W69-10163

7C. Evaluation, Processing and Publication

PROCESSING OF DIGITAL DATA LOGGER STD TAPES AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AND THE BUREAU OF COMMERCIAL FISHERIES, LA JOLLA, CALIFORNIA,
Bureau of Commercial Fisheries, La Jolla, Calif. Fish-Oceanographic Center.
James H. Jones.

Fish and Wildlife Serv Spec Sci Rep-Fish No 588, June 1969. 25 p, 6 fig, 1 append.

Descriptors: *Data processing, *Hydrologic data, *Water quality, *Computer programs, Digital computers, Water temperature, Salinity, Depth, Remote sensing, Oceans, Sampling.
Identifiers: Salinity-temperature-depth data processing.

The development of continuous sampling STD (salinity-temperature-depth) sensors as a prime data collection tool for oceanographic cruises has necessitated the development of techniques capable of handling the data with modern digital computing equipment. One such technique that was developed for processing STD data collected as part of the EASTROPAC Survey Program is described. The description assumes that the data has been digitized and recorded on IBM compatible tape in the field. The computer programs needed for processing the basic data tapes are described, and a listing of the program with subroutines is given in an Appendix. (Knapp-USGS)
W69-09894

MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER,
Nevada Univ., Reno. Desert Research Inst.
For primary bibliographic entry see Field 06A.
W69-09918

NUMERICAL SIMULATION OF WAVE-CREST MOVEMENT IN RIVERS AND ESTUARIES,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W69-09919

COMPUTER TECHNOLOGY IN EVAPORATION STUDIES,
New Mexico State Univ., University Park. Dept. of Civil Engineering; and New Mexico State Univ., University Park. Engineering Experiment Station. For primary bibliographic entry see Field 02D. W69-09930

COMPARISON BETWEEN ANALOG AND DIGITAL SIMULATION TECHNIQUES FOR AQUIFER EVALUATION,
Illinois State Water Survey, Urbana.

T. A. Prickett, and C. G. Lonnquist.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Vol 2, Int Ass Sci Hydrol, Publ No 81, p 625-634, 1968. 10 p, 4 fig, 14 ref.

Descriptors: *Computer models, *Analog computers, *Digital computers, *Groundwater, Aquifers, Simulation analysis, Model studies, Numerical analysis, Mathematical models, Synthetic hydrology, Groundwater movement, Streamflow, Operations research, Analog models, Computer programs.

Identifiers: Computer model comparisons, Aquifer evaluation.

Several comparisons are made between electric analog and digital computer techniques in the evaluation of aquifer systems. The analog method described involves electronic analyzers coupled to an array of electrical resistors and capacitors simulating a scaled-down version of the aquifer. The digital solutions described are obtained by implicit numerical integration. Comparisons are first made by noting the similarities between 2 computational methods. The most important similarities include basic data requirements, method of discretizing the space variables, assigning hydrogeologic properties to the discrete portions of the model, verification of the model, and analysis of the basic problem. It was found that the main difference between the analog and digital computational techniques fall basically into 4 categories: (1) The digital method does not require as much time for model construction and data readout and is more convenient than the equipment manipulation phases needed in the analog technique; (2) the digital computer offers more versatility than the analog for solving nonlinear boundary problems; (3) the analog technique offers the advantage of an in-house simulator for a large class of groundwater problems and when it is desired to solve problems requiring an insight into the behavior of the physical system; and (4) the analog technique offers advantages when solving large problems. Factors related to accessibility of equipment and costs dictate to a large extent the simulation technique choice. (Knapp-USGS)

W69-09931

HYDROLOGIC DISTRIBUTIONS RESULTING FROM MIXED POPULATIONS AND THEIR COMPUTER SIMULATION,
Illinois State Water Survey, Urbana.

Krishan P. Singh.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Vol 2, Int Ass Sci Hydrol, Publ No 81, p 671-681. 11 p, 4 fig, 2 tab, 9 ref.

Descriptors: *Model studies, *Computer models, *Synthetic hydrology, Simulation analysis, Data processing, Statistical methods, Regression analysis, Parametric hydrology, Hydrographs, Computer programs, Probability.

Identifiers: Hydrologic simulation.

Distributions of many hydrologic variables do not conform to any one standard distribution. For example, the monthly streamflow involves a chain of causes and effects, with infinite temporal and spatial variations. The population and distribution of monthly streamflows therefore are considered as a mixed population and distribution. In order to keep the problem simple and solvable on the computer, a 2-population model is postulated for a mixed

population for each of the 12 monthly streamflows. The salient features of the computer program developed for obtaining the 2-component distributions are described. The results of analyses of some streamflow records in Illinois show that observed monthly streamflow distributions can be simulated satisfactorily by the 2-component distributions obtained from the computer analysis of the parent distribution. The parameters of the component distributions exhibit distinct annual cycles as may be expected from physical reasoning. (Knapp-USGS) W69-09935

IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL,
All-Union Scientific Research Inst. of Hydrotechnics and Reclamation (USSR). For primary bibliographic entry see Field 06A. W69-09936

USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW PROBLEMS IN AQUIFER SYSTEMS,
California Univ., Berkeley.

P. A. Witherspoon, I. Javandel, and S. P. Neuman. Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Vol 2, Int Ass Sci Hydrol, Publ No 81, p 687-698, 1968. 12 p, 6 fig, 19 ref.

Descriptors: *Unsteady flow, *Groundwater movement, *Mathematical models, *Digital computers, Numerical analysis, Aquifers, Flow, Porous media, Synthetic hydrology, Permeability, Anisotropy. Identifiers: Finite element method, Transient flow problems.

The finite element method is a new numerical approach for solving transient flow problems that is particularly well adapted to digital computers. In this method the partial differential equation together with the appropriate initial and boundary conditions are replaced by a corresponding variational problem. The continuum is replaced by a finite number of subregions, and the variational principle is expressed as a summation of functionals over the entire network. The resulting functional is minimized by direct methods of the calculus of variations to yield the solution to the original boundary value problem. To demonstrate the validity of this new technique, results obtained by the finite element method are compared to analytical solutions from the literature. To demonstrate the power of this approach, solutions for the more complex problem of transient flow in layered systems with crossflow are also presented. An example of results for a 2-layer aquifer is discussed. A second example of results for a 3-layer system consisting of 2 aquifers enclosing an aquiclude is also discussed. The finite element method is completely general with respect to geometry, boundary conditions and rock properties and provides a powerful new method of solving fluid flow problems in complex systems. (Knapp-USGS)

W69-09937

INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering. For primary bibliographic entry see Field 02A. W69-10098

WATER RESOURCES RESEARCH CATALOG, VOLUME FOUR.
Smithsonian Institution, Washington, D.C. Science Information Exchange. For primary bibliographic entry see Field 10. W69-10115

SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
Pennsylvania Dept. of Forests and Waters, Harrisburg; and Pittsburgh Univ., Pa. For primary bibliographic entry see Field 05D. W69-10128

USE OF A MATHEMATICAL MODEL IN THE HYDROLOGIC STUDY AS APPLIED TO THE VEGA DE GRENADE DE SPAIN (FRENCH),
For primary bibliographic entry see Field 02F. W69-10147

A TABLE FOR CONVERTING pH TO HYDROGEN ION CONCENTRATION (H⁺) OVER THE RANGE 5-9,
Civil Aeromedical Inst., Oklahoma City, Okla. For primary bibliographic entry see Field 02K. W69-10148

08. ENGINEERING WORKS

8A. Structures

SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958,
Research Inst. for Water Resources Development, Budapest (Hungary). Dept. for Hydraulic Engineering Research. K. Stelczer.

Dep Hydraul Eng Res Rep, Res Inst Water Resources Develop, 1967. 109 p, 102 fig, 272 ref.

Descriptors: *Hydraulic structures, *Hydraulic machinery, *Testing, *Instrumentation, Watersheds (Basins), Dams, Erosion, Lakes, Streamflow, Irrigation systems, Plastics, Soil moisture meters, Soil density, Soil properties. Identifiers: *Hungary, Hydraulic research.

A monograph containing 40 articles, this is a review and presentation of the overall picture of hydraulic construction research in Hungary from 1958 to 1967. The monograph gives titles of 272 publications by members of the scientific staff of the Hungarian Research Institute for Water Development (1958 to 1966). Besides giving a list of research papers, the publication will facilitate those engaged in similar work abroad in contacting personnel at the Institute regarding common problems. (Gabriel-USGS)

W69-09939

DETERMINATION OF DYNAMIC PRESSURE OF WATER ON A DAM USING THE EHDA METHOD AND TAKING INTO CONSIDERATION THE DAM ELASTICITY (RUSSIAN),
For primary bibliographic entry see Field 08B. W69-10099

SEMPOR PROJECT-GENERAL PLAN,
Ministry of Public Works and Power, Djakarta (Indonesia). Water Resources Development. Rachmat Tirtojondro. Indones Min Public Works and Power, Water Resources Develop Rep, Mar 1969. 27 p, 5 tab, 36 ref, 39 append.

Descriptors: *Water structure, *Water supply, *Water storage, *Reclamation, *Irrigation engineering, River basins, Cultivated lands, Foods, Population, Rainfall, Mapping, Dry seasons, Discharge measurement, Water yield, Geology, Water resources, Gaging stations. Identifiers: Central Java, Sempor reservoir, *Indonesia.

This monograph discusses an over-all plan for construction of the Sempor reservoirs and several main canals in Central Java and for the improvement and extension of the existing distribution systems. Under this plan, 13,900 hectares of rice fields in the Karanganjar plain will receive an irrigation

Field 08—ENGINEERING WORKS

Group 8A—Structures

water supply to secure two rice crops and one non-rice crop a year. In addition the floods, which result from poor natural drainage, will be controlled to some extent. The net capacity of the reservoir is designed to be 60 million cu m with a normal elevation level of +76 m. The estimated total project cost is \$20,090,000. (Gabriel-USGS)

W69-10100

8B. Hydraulics

LONGITUDINAL DISPERSION IN OPEN CHANNELS,
Pittsburgh Univ., Pa.
For primary bibliographic entry see Field 02E.
W69-09888

RESISTANCE TO REVERSING FLOWS OVER MOVABLE BEDS,
Technical Univ. of Istanbul (Turkey).
For primary bibliographic entry see Field 02E.
W69-09892

FRICITION-FACTORS FOR FLAT-BED FLOWS IN SAND CHANNELS,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 02E.
W69-09893

SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958,
Research Inst. for Water Resources Development, Budapest (Hungary). Dept. for Hydraulic Engineering Research.
For primary bibliographic entry see Field 08A.
W69-09939

DETERMINATION OF DYNAMIC PRESSURE OF WATER ON A DAM USING THE EHDA METHOD AND TAKING INTO CONSIDERATION THE DAM ELASTICITY (RUSSIAN),
G. P. Mamradze, and T. I. Metrebeli.
English summary provided with Russian text.
Soobshch Akad Nauk, Gruz, SSR (Bull Acad Sci of Georgian SSR), Vol 53, No 3, p 657-660, Mar 1969. 4 p, 4 ref.

Descriptors: *Dam construction, *Dynamics, *Pressure, *Mathematical studies, Dams, Bottom sediments, Laplace's equation, Mechanical properties, Energy dissipation, Elastic deformation, Earthquake engineering, Soil dynamics, Vibrations, Resonance, Reservoirs.
Identifiers: Earthquake stresses (Dams).

Dynamic pressure of water on dams due to earthquakes was analytically investigated. By assuming a concept of spectral seismic stability, the final solutions expressed in terms of the proper vibrations of a dam and the soil, damping coefficient and other parameters are developed. (Gabriel-USGS)

W69-10099

METHOD OF DETERMINING THE DISCHARGE OF TWO-LEVEL SPILLWAYS,
Sredneaziatskii Nauchno-Issledovatel'skii Institut Irrigatsii, Tashkent (USSR).

B. G. Polyakova.

Transl from Izvestiya Akad Nauk Uzbekskoy SSR, Ser Tekhn. Nauk, No 1, 1968, p 53-57. Soviet Hydrol Selec Pap No 3, p 296-299, 1968. 4 p, 1 fig, 9 ref.

Descriptors: *Discharge (Water), *Spillways, *Hydraulics, Outlet works, Overflow, Discharge measurement, Discharge coefficients.
Identifiers: *2-level spillways.

Methods are given for calculating flow of 2-level spillways having a horizontal gate or bridge and a lower horizontal overflow sill. No analytical method exists for such calculations, so a semi-empirical method was developed to use experimentally obtained flow resistance coefficients and structural dimensions. Nomograms are plotted to show the relationships developed and to use them to compute discharge. (Knapp-USGS)

W69-10129

mal stress, Pressure, Rocks, Physical properties, Rock properties, Boreholes, Porosity.
Identifiers: Fluid flow in porous media.

The application of the equations of elasticity developed by Seth and Gray (1968) for infinite reservoirs are applied to the study of finite reservoirs. The following cases are investigated: (1) steady-state flow; (2) constant pressures at the borehole and outer boundary; and (3) constant pressure at the borehole and no flow at the outer boundary. Radial stresses are compressive or neutral, whereas tangential and vertical stresses may be tensile, neutral, or compressive, depending upon the boundary conditions, the physical properties of the system, and the radial distance involved. For constant boundary pressures, both radial and tangential stresses increase with time whereas they both decrease for a closed outer boundary and constant pressure at the borehole. For steady-state systems, radial displacement may be positive or negative depending upon the dimensions of the system, the pressure difference, and porosity. (Gabriel-USGS)

W69-09926

8C. Hydraulic Machinery

SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958,

Research Inst. for Water Resources Development, Budapest (Hungary). Dept. for Hydraulic Engineering Research.

For primary bibliographic entry see Field 08A.
W69-09939

ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W69-09972

8E. Rock Mechanics and Geology

GEOLOGY OF PROPOSED POWERSITES AT DEER LAKE AND KASNYKU LAKE, BARANOF ISLAND, SOUTHEASTERN ALASKA,

Geological Survey, Washington, D.C.

Alexander A. Wanek, and James E. Callahan.
Geol Surv Bull 1211-C, 1969. 25 p, 1 fig, 1 plate, 1 tab, 23 ref.

Descriptors: *Geology, *Alaska, *Geologic investigations, *Hydroelectric power, *Damsites, Engineering geology, Dam foundations, Tunnels, Rock properties, Rock mechanics.
Identifiers: Damsite geology (Baranof Island).

Proposed powersites are on the east side of Baranof Island, southeastern Alaska. One powersite is at Kasnyk Lake in the northern part of Baranof Island, 20 mi northeast of Sitka; the other is at Deer Lake in the southern part of Baranof Island, 48 mi south of Kasnyk Lake. The region is rugged, mountainous, and extremely glaciated and lies within the Chilkat-Baranof Mountains section of the Pacific Border Ranges province. Southern Baranof Island is underlain by metamorphic rocks of Triassic to Cretaceous age that are intruded by dioritic rocks. Northern Baranof Island is underlain by metamorphosed sedimentary rocks that range from probably Paleozoic to Cretaceous age. These rocks form 2 broad structural features, a northwest-trending anticlinorium flanked by a north-northwest-trending synclinorium. The northeast and northwest sides of northern Baranof Island are bound by northwest-trending lineaments that are probably traces of major faults. Many of the conspicuous linear features on Baranof Island are believed to be along prominent joint systems. No evidence of faulting was found at the powersites. The waterpower developments would be best accomplished by the construction of dams to raise the lake levels and by drawdown below normal lake level for maximum power capacity. (Knapp-USGS)

W69-09911

ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION,

Texas Univ., Austin.

G. M. Myers, and K. E. Gray.

Trans Soc Petrol Eng, Amer Inst Mining, Met, and Petrol Eng, Inc, Vol 243, Part 2, p 163-173, 1968. 11 p, 19 fig, 3 tab, 9 ref.

Descriptors: *Rock mechanics, *Drilling, *Rock properties, *Dynamics, *Filtration, Stress analysis, Saline water, Saturated flow, Geology, Sandstones, Pore pressure, Mud, Boreholes, Plasticity, Tensile pressure, Drilling equipment, Simulation analysis.
Identifiers: Borehole rock failure.

The effects of single-blow bit-tooth impacts on salt water-saturated Berea and Bandera sandstone samples were investigated under conditions of elevated confining and pore pressure. During the tests dynamic filtration and deposition of a mud cake were taking place due to the presence of drilling mud in the borehole and a borehole-to-formation pressure differential. The saturation of those sandstones with salt water tends to make them weaker than when saturated with nonreactive fluids. Plastic failure often occurs even when extremely high-fluid-loss muds are present in the borehole. Brittle failure of sandstones in mud-filled boreholes is found to be relatively rare. In general the withdrawal of the bit induces a tensile force of considerable magnitude. (Gabriel-USGS)

W69-09927

VELOCITY OF COMPRESSIVE WAVES IN POROUS MEDIA AT PERMAFROST TEMPERATURES,

Chevron Research Co., La Habra, Calif.

For primary bibliographic entry see Field 02C.

W69-10138

8G. Materials

EVALUATION AND CONTROL OF CORROSION AND ENCRUSTATION IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN,

Geological Survey, Washington, D.C.

Frank E. Clarke, and Ivan Barnes.

Geol Surv Water-Supply Pap 1608-L, p L1-L61, 1969. 61 p, 40 fig, 5 tab, 13 ref.

Descriptors: *Corrosion, *Well screens, *Casings, Corrosion control, Saline water, Saline soils, Drainage, Well filters, Saturated soils, Iron, Calcium, Sulfur bacteria, Carbonates, Iron bacteria.
Identifiers: *Pakistan, *Indus Plains, Well screen encrustation, Inert well casings.

Waterlogging and soil salinization problems in much of the Indus Plains of West Pakistan are being overcome in part by tube-well dewatering

and deep leaching of salinized soils. The groundwaters are anaerobic and some are supersaturated with calcium carbonate (calcite) and iron carbonate (siderite). These waters are moderately corrosive to steel. Sulfate-reducing bacteria catalyze corrosion. Corrosion is concentrated in the relatively active (anodic) saw slots of water-well filter pipes, where metal loss is least tolerable. Deposition of calcium carbonate, iron carbonate, and other minerals clog the filter pipes. In some places well capacities are seriously reduced in very short periods of time. There appears to be no practicable preventive treatment for corrosion and encrustation in these wells. Periodic rehabilitation by down-hole blasting or other effective mechanical or chemical cleaning methods will prolong well life. The most promising approach to future well-field development is to use filter pipes of epoxy-resin-bonded fiber glass, stainless steel, or other inert material which minimizes both corrosion and corrosion-catalyzed encrustation. Fiberglass plastic pipe appears to be the most economically practicable, and already is being used with promising results. (Knapp-USGS)

W69-09910

IMPROVED SEALANTS FOR INFILTRATION CONTROL, The Development and Demonstration of Materials to Reduce or Eliminate Water Infiltration Into Sewage.

Federal Water Pollution Control Administration, Washington, D.C.

For primary bibliographic entry see Field 05G.

W69-10255

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

WATER RESOURCES RESEARCH INTERESTS IN THE SENIOR COLLEGES AND UNIVERSITIES OF NORTH CAROLINA.

North Carolina Univ., Chapel Hill. Water Resources Research Inst.

For primary bibliographic entry see Field 09C.

W69-10083

INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA.

North Carolina Univ., Chapel Hill. Water Resources Research Inst.

N C Univ Water Resources Res Inst Rep, July 1, 1969. 72 p. OWRR Proj No A-999-NC.

Descriptors: *Projects, *Research facilities, *Research and development, *Water resources development, *North Carolina, Reviews, Surveys, Data collections, Documentation, Laboratories, Universities.

Identifiers: *Water resources research.

An inventory of all water resources projects in North Carolina in 1969 is presented. Organizations conducting research include colleges and Universities, private industry, State agencies, and Federal agencies. Each project description includes title, location, work description, starting and completion dates, and names of researchers. (Knapp-USGS)

W69-10084

9C. Research Facilities

FOREST HYDROLOGY RESEARCH IN THE UNITED STATES.

Forest Service (USDA), Washington, D.C.

Clark E. Holscher.

Int Symp on Forest Hydrol, Penn State Univ, Aug 29-Sept 10, 1965. p 99-103, Pergamon Press, New York, 1066.

Descriptors: *Hydrologic aspects, *Watershed management, *Forest management, *Water yield improvement, Rehabilitation, Rainfall-runoff relationships, Snow management, Vegetation effects, Flood protection, Soil stabilization, Evapotranspiration.

Identifiers: *Watershed protection, Soil improvement.

Forest influences has concerned foresters since 1893, although the first research began only in 1912 at Wagon Wheel Gap in Colorado. Since then, research in forest hydrology has spread nationwide; the Forest Service conducts most of it, but the universities have rapidly growing programs. Well over half the effort is still in applied research, oriented toward the solution of problems. Many facets of forest hydrology research are discussed. (Reigner-Forest Ser)

W69-10006

WATER RESOURCES RESEARCH INTERESTS IN THE SENIOR COLLEGES AND UNIVERSITIES OF NORTH CAROLINA.

North Carolina Univ., Chapel Hill. Water Resources Research Inst.

W69-10295

N C Univ Water Resources Res Inst Rep, July 1, 1969. 19 p. OWRR Proj No A-999-NC.

Descriptors: *Projects, *Research and development, *Water resources development, *North Carolina, Surveys, Data collections, Laboratories, Universities.

Identifiers: *Water resources research.

The water resources research interests of the staffs of the colleges and universities of North Carolina are listed. The information given is college or university name, school, department, researcher's name, and his fields of interest. (Knapp-USGS)

W69-10083

INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA.

North Carolina Univ., Chapel Hill. Water Resources Research Inst.

For primary bibliographic entry see Field 09A.

W69-10084

9D. Grants, Contracts, and Research Act Allotments

WATER RESOURCES RESEARCH CATALOG, VOLUME FOUR.

Smithsonian Institution, Washington, D.C. Science Information Exchange.

For primary bibliographic entry see Field 10.

W69-10115

ANNUAL REPORT, FISCAL YEAR 1969,

North Carolina Water Resources Research Inst., Raleigh.

David H. Howells.

WRRI-UNC Unnumbered Report, 1969. 46 p. OWRR Contract 14-01-0001-1853.

Descriptors: *Water resources research, Education.

The Water Resources Research Institute is North Carolina's water research center. A unit of the Consolidated University, located at North Carolina State University, it works closely with the North Carolina Department of Water and Air Resources and other agencies in the formulation of a research program responsive to State water resources problems. A twenty-five man Advisory Committee representative of State and Federal water agencies, industry agriculture, and local government provides guidance and review. The Institute's research program for fiscal year 1968-69 was supported by the annual allotment and eight matching grants from the Office of Water Resources Research, non-federal matching and other funds from the Consolidated University of North Carolina and private industry, and two grants from the North Carolina Department of Water and Air Resources. Action by the North Carolina Legislature appropriating funds in partial support of the Institute during the next biennium greatly strengthened the federal-state cooperative relationship underlying this program and placed it on a firm foundation for the future. Report contains description of water resource problems and related research projects, summary of research findings, and discussion of program development, education, and public service programs.

W69-10295

10. SCIENTIFIC AND TECHNICAL INFORMATION

SELECTED URBAN STORM WATER RUNOFF ABSTRACTS.

Franklin Inst. Research Labs., Philadelphia, Pa. Science Information Services.

For primary bibliographic entry see Field 04C.

W69-10085

WATER RESOURCES RESEARCH CATALOG, VOLUME FOUR.

Smithsonian Institution, Washington, D.C. Science Information Exchange.

Dep of Interior, Office of Water Resources Res Sci Inform Center Rep, Vol 4, Dec 1968. 1315 p, 4 index. Available from Supt of Documents, Wash, DC, 20402, for \$8.50 a copy, order as Catalog No 11.94:4.

Descriptors: *Research and development, *Projects, *Water resources development, *Contracts, Programs, Project planning, Project purposes, Federal government, Federal project policy.

Identifiers: *Water resources research catalog.

The Water Resources Research Catalog, vol 4 is a tabulation of descriptions of 4,501 research projects, most of which are funded by the U.S. Government. Some of the projects are independently funded and voluntarily reported. Each project description includes the name of the investigator, title of the project, object of study, plan of work, and source of support. The catalog lists 5,749 investigators, 781 performing organizations (194 of which are Federal), and 320 supporting organizations (31 of which are Federal). (Knapp-USGS)

W69-10115

SUBJECT INDEX

ABLATION		
GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECEDITION IN THE MARVIKSKJOMEN DISTRICT, NORWAY,		
W69-09924	02C	
ABSTRACTS		
SELECTED URBAN STORM WATER RUNOFF ABSTRACTS.		
W69-10085	04C	
ACID MINE WATER		
EFFECTS OF SURFACE MINING ON THE FISH AND WILDLIFE RESOURCES OF THE UNITED STATES,		
W69-10137	05C	
ACTIVATED ALUMINA		
REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA,		
W69-10176	05G	
ACTIVATED SLUDGE		
JOINT MUNICIPAL AND SEMICHEMICAL PULPING WASTE TREATMENT, A PILOT STUDY EVALUATING COMBINED TREATMENT OF DOMESTIC SEWAGE AND WEAK SEMICHEMICAL PULPING AND PAPERMAKING WASTES.		
W69-10253	05D	
KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS.		
W69-10258	05D	
DETERMINATION OF THE DEGRADABILITY OF SYNTHETIC DETERGENTS.		
W69-10285	05D	
ACTIVITY ANALYSIS		
CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS,		
W69-09980	06B	
ACTIVITY ANALYSIS IN WATER PLANNING,		
W69-09982	06B	
ACTUARIAL MODEL		
RESOURCE ALLOCATION WITH PROBABILISTIC INDIVIDUAL PREFERENCES,		
W69-09956	06C	
ADAPTIVE RADIATION		
EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCEA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY.		
W69-10149	02H	
ADJUDICATION PROCEDURE		
LEVEE AND DRAINAGE DISTRICTS.		
W69-10076	06E	
ADMINISTRATION		
WATER RIGHTS AND ADMINISTRATION WITH RESPECT TO SOIL AND WATER CONSERVATION,		
W69-10221	06E	
ADMINISTRATIVE AGENCIES		
DAMS.		
W69-10027	06E	
DEPARTMENT OF WATER RESOURCES.		
W69-10032	06E	
CANALS AND WATERWAYS, RIVERS, LAKES, STREAMS.		
W69-10043	06E	
LEVEE IMPROVEMENT COMMISSION.		
W69-10047	06E	
STATE HIGHWAYS.		
W69-10051	06E	
STATE CONSERVATION COMMISSION.		
W69-10053	06E	
WATER DRAINAGE AND LEVEE DISTRICTS.		
W69-10061	06E	
POLLUTION OF STREAMS.		
W69-10071	05G	
ERCTION AND INSPECTION OF DAMS.		
W69-10223	04A	
DRAINAGE OF LOW LANDS.		
W69-10225	04A	
FISH.		
W69-10227	06E	
GAME AND FISH REFUGES.		
W69-10231	06E	
REUTER V DEPT OF NATURAL RESOURCES (ADMINISTRATIVE FINDING OF EFFECTS UPON WATER POLLUTION AS PREREQUISITE TO ISSUANCE OF DREDGING PERMITS).		
W69-10242	05G	
DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.		
W69-10243	04A	
W69-10244	04A	
W69-10245	04A	
GREAT LAKES RIVER BASINS COMMISSION.		
W69-10247	06B	
ADSORPTION		
DISTRIBUTION OF PESTICIDES IN SURFACE WATERS,		
W69-09884	05B	
ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS		
TRENDS IN METROPOLITAN WATER DEVELOPMENT,		
W69-10195	06B	
ADVOCACY		
ADVOCACY AND RESOURCE ALLOCATION DECISIONS IN THE PUBLIC SECTOR,		
W69-10203	06B	
AERATION		
CHEMISTRY OF N AND NH IN COX HOLLOW LAKE,		
W69-09881	05A	
AERATION RECOVERY OF LANOLIN FROM WOOL SCOUR LIQUORS,		
W69-10286	05G	
BLEACHERY WASTES TREATED BY NUTRIENTS AND HIGH-RATE FILTER PLANT,		
W69-10289	05D	
AERIAL PHOTOGRAPHY		
MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS,		
W69-09914	05B	
AEROBIC TREATMENT		
AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH),		
W69-10088	05D	
KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS.		
W69-10258	05D	
SIMPLE BIO-AERATION KILLS STRONG WASTES CHEAPLY.		
W69-10276	05G	
AFRICA		
GEOCHEMICAL EVOLUTION OF OUED SAOURA (NORTHWESTERN SAHARA) WATERS (FRENCH),		
W69-10114	02K	
AGGREGATION		
SIMULATION OF INDIVIDUAL AND GROUP BEHAVIOR,		
W69-09950	06A	
AGRICULTURE		
STUDY OF IRRIGATION BY SPRINKLING (FRENCH),		
W69-09903	03F	
ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION,		
W69-09972	06A	
WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA.		
W69-10294	03F	
AIR SPRAY		
COPPER SULPHATE AIR SPRAY CURES LAKE ALGAE PROBLEM,		
W69-10155	05G	
ALABAMA		
FLOODPLAIN INFORMATION, FIVE MILE CREEK, METROPOLITAN BIRMINGHAM, ALABAMA.		
W69-09896	04A	
ALASKA		
GEOLOGY OF PROPOSED POWERSITES AT DEER LAKE AND KASHNIKU LAKE, BARANOF ISLAND, SOUTHEASTERN ALASKA,		
W69-09911	03E	
PERMAFROST AND RELATED ENGINEERING PROBLEMS IN ALASKA,		
W69-10106	02C	
RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA,		
W69-10172	02K	
CHANGE IN DISTRIBUTION AND AVAILABILITY OF NITROGEN WITH FOREST SUCCESSION ON NORTH SLOPES IN INTERIOR ALASKA,		
W69-10173	02K	
ALGAE		
EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO,		
W69-10158	05C	
ALGAL RESPIRATION IN A EUTROPHIC ENVIRONMENT,		
W69-10159	05B	
TEMPERATURE OPTIMA FOR ALGAL DEVELOPMENT IN YELLOWSTONE AND ICELAND HOT SPRINGS,		
W69-10160	05C	
ALGAE AND PHOSPHORUS IN LAKE MINNETONKA,		
W69-10167	05C	
STUDIES ON MORPHOGENESIS IN A BLUE-GREEN ALGA. I. EFFECT OF		

INORGANIC NITROGEN SOURCES ON DEVELOPMENTAL MORPHOLOGY OF ANABAENA DOLIOLUM, W69-10177	05C	AQUIFER STORAGE AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAMED WASTEWATER, W69-10187	03P
THE IMPORTANCE OF EXTRACELLULAR PRODUCTS OF ALGAE IN FRESHWATER, W69-10180	05C	AQUIFERS IRMAY'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE, W69-09909	02P
ALGAL CONTROL COPPER SULPHATE AIR SPRAY CURES LAKE ALGAE PROBLEM, W69-10155	05G	GROUNDWATER IN OGALLALA FORMATION IN THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO, W69-09913	02P
ALGAE CONTROL WITH COPPER SULFATE, W69-10157	05G	GROUNDWATER RESOURCES OF PAMPANGA PROVINCE, W69-09948	02P
ALKALINE WATERS ASPECTS OF THE OCCURRENCE AND MIGRATION OF NIOBium, BERYLLIUM, AND RARE EARTHS IN NATURAL ALKALINE WATERS, W69-10116	02K	IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS, W69-10019	02P
ALLUVIAL CHANNELS RESISTANCE TO REVERSING FLOWS OVER MOVABLE BEDS, W69-09892	02E	WATER-LEVEL CHANGES 1964-1968, NORTHERN HIGH PLAINS OF COLORADO, W69-10094	02P
FRICITION-FACTORS FOR PLAT-BED FLOWS IN SAND CHANNELS, W69-09893	02E	DEPOSITIONAL ENVIRONMENTS OF SUBSURFACE POTOMAC GROUP IN MARYLAND, W69-10113	02J
EXPERIMENTAL PALEOHYDROLOGIC INVESTIGATIONS, W69-10141	02E	ASPECTS OF THE OCCURRENCE AND MIGRATION OF NIOBium, BERYLLIUM, AND RARE EARTHS IN NATURAL ALKALINE WATERS, W69-10116	02K
ALLUVIUM HYDROGEOLGY OF THE SCIOTO RIVER VALLEY NEAR PIKETON, SOUTH-CENTRAL OHIO, W69-10105	02F	ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS, W69-10117	02K
ANABAENA DOLIOLUS STUDIES ON MORPHOGENESIS IN A BLUE-GREEN ALGA. I. EFFECT OF INORGANIC NITROGEN SOURCES ON DEVELOPMENTAL MORPHOLOGY OF ANABAENA DOLIOLUM, W69-10177	05C	NATURAL RADIODEMENTS IN SURFACE AND UNDERGROUND WATERS, W69-10118	02K
ANALOG COMPUTERS COMPARISON BETWEEN ANALOG AND DIGITAL SIMULATION TECHNIQUES FOR AQUIFER EVALUATION, W69-09931	07C	ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM, W69-10119	02K
ANALOG MODELS SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM, W69-10128	05D	ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS, W69-10120	02K
ANALYTICAL TECHNIQUES THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES, W69-09938	06A	ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K
A REVIEW OF THE LITERATURE OF 1964 ON WASTE WATER AND WATER POLLUTION CONTROL, W69-10271	05D	USE OF A MATHEMATICAL MODEL IN THE HYDROLOGIC STUDY AS APPLIED TO THE VEGA DE GRENADE OF SPAIN (FRENCH), W69-10147	02F
A REVIEW OF THE LITERATURE OF 1963 ON WASTE WATER AND WATER POLLUTION CONTROL, W69-10272	05D	ARABIAN GULF MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING BRINES, THE SABKHA, TRUCIAL COAST, ARABIAN GULF, W69-09906	02L
ANEMOMETERS HEATED THERMOPILE ANEMOMETER COMPARED WITH SENSITIVE CUP ANEMOMETER IN NATURAL AIRFLOW, W69-09985	07B	ARGON ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS, W69-10120	02K
ANIMAL WASTES WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA, W69-10294	03F	ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K
APPALACHIAN MOUNTAIN REGION GEOLOGIC CONTROL OF RAINFALL-RUNOFF RELATIONS IN THE PEAK CREEK WATERSHED, PULASKI AND WYTHE COUNTIES, VIRGINIA, W69-10090	02A	ARKANSAS FLOODPLAIN INFORMATION, FOURCHE CREEK AND TRIBUTARIES, LITTLE ROCK, ARKANSAS - PART 1, W69-09898	04A
APPRaisALS LEVEE AND DRAINAGE DISTRICTS, W69-10076	06E	ARKANSAS WATER RESOURCES SUPPLY, USE, AND RESEARCH NEEDS, W69-09940	06D
AQUATIC BACTERIA WATER QUALITY OF MOUNTAIN WATERSHEDS, W69-09943	05B	DRAINAGE OF ROADBED, W69-09945	06E
PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES, W69-10171	05F	WATER DRAINAGE AND LEVEE DISTRICTS, W69-10061	06E
AQUATIC MICROBIOLOGY PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES, W69-10171	05F	W69-10062	06E
AQUATIC MICROORGANISMS FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY, W69-09901	02L	W69-10063	06E
AQUEOUS SOLUTIONS EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS--2. APPLICATIONS, W69-10092	01B	W69-10064	06E
SILICA IN AQUEOUS SOLUTIONS, W69-10122	01B	ARKANSAS IRRIGATION, DRAINAGE AND WATERSHED IMPROVEMENT DISTRICT ACT OF 1949, W69-10065	06E
		IMPROVEMENT DISTRICTS OF RIVER WATER - DRAINAGE AND LEVEE DISTRICTS, W69-10066	06E
		ARTESIAN WELLS, W69-10067	06E
		WATER CONSERVATION COMMISSION, W69-10068	06E
		WATER POWER COMPANIES, W69-10069	06E
		INTERSTATE WATERSHED COOPERATION ACT., W69-10070	06E
		POLLUTION OF STREAMS.	

SUBJECT INDEX

ARK-BOT

W69-10071	05G	ANALYSIS CASE STUDY, W69-10190	05G
FLOOD CONTROL.		BIOLOGICAL OXYGEN DEMAND (BOD) OF STARCH AND STARCH DERIVATES (IN DUTCH), W69-10269	05D
W69-10072	06E		
SALE OF ISLANDS.		WASTE-TREATMENT EXPERIENCE REPORTED, W69-10281	05D
W69-10073	06E	CMC KAYOED STREAM POLLUTION. W69-10287	05D
REMOVAL OF SAND AND GRAVEL FROM NAVIGABLE WATERS AND SALE OR LEASE OF MINERALS ON STATE LANDS. W69-10074	06E	DISPOSAL OF COMBINED TEXTILE FINISHING WASTES AND DOMESTIC SEWAGE, W69-10288	05D
PACKET AND NAVIGATION COMPANIES--COAL AND STONE COMPANIES. W69-10075	06E		
LEVEE AND DRAINAGE DISTRICTS.		BIODEGRADATION THE DECOMPOSITION OF PETROLEUM PRODUCTS IN OUR NATURAL WATERS, W69-10082	05B
W69-10076	06E		
NAVIGABLE WATERCOURSES AS FENCES. W69-10077	06E	BIODEGRADATION BIODEGRADABLE SURFACTANTS FOR THE TEXTILE INDUSTRY, W69-10259	05D
REGIONAL WATER DISTRIBUTION DISTRICT ACT. W69-10234	04A		
WHITE RIVER NAVIGATION DISTRICT COMMISSION. W69-10235	04A	SURFACE-ACTIVE AGENTS IN TEXTILE PROCESSES AND THEIR EFFECT ON EFFLUENTS, W69-10260	05D
ARKANSAS WATERWAYS COMMISSION. W69-10236	04A	UNION CARBIDE'S BIODEGRADABLE SURFACTANTS FIGHT POLLUTION. W69-10262	05G
ARTESIAN WELLS ARTESIAN WELLS.		DETERMINATION OF THE DEGRADABILITY OF SYNTHETIC DETERGENTS, W69-10285	05D
W69-10067	06E		
ASPEN(COLO) EPIDEMIC GIARDIASIS AT A SKI RESORT, W69-10079	05C	BIOLOGICAL TREATMENT BILOGICAL TREATMENT OF TEXTILE EFFLUENTS, W69-10261	05D
ASSESSMENTS LEVEE AND DRAINAGE DISTRICTS.			
W69-10233	04A	WASTE TREATMENT AT CANNON MILLS, W69-10282	05D
ASYMPTOTIC TESTS ALTERNATIVE ASYMPTOTIC TESTS OF SIGNIFICANCE AND RELATED ASPECTS OF 2SLS AND 3SLS ESTIMATED PARAMETERS, W69-09953	06A	BLEACHERY AND DYEHOUSE WASTE STUDIES, W69-10283	05D
ATLANTIC OCEAN ARAGONITE-CEMENTED SANDSTONE FROM OUTER CONTINENTAL SHELF OFF DELAWARE BAY SUBMARINE LITHIFICATION MECHANISM YIELDS PRODUCT RESEMBLING BEACHROCK, W69-09908	02L	BLEACHERY WASTES TREATED BY NUTRIENTS AND HIGH-RATE FILTER PLANT. W69-10289	05D
AUSTRIA TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD, W69-10181	02H		
BACTERIA PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES, W69-10171	05F	BIOLOGY FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY, W69-09901	02L
BACTERICIDES PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES, W69-10171	05F	BISULFITES PURIFICATION OF INDUSTRIAL WASTES (IN GERMAN), W69-10264	05D
BANK EROSION STREAM CAVING AND ROAD CONSTRUCTION. W69-10299	04C	BLANEY-CRIDDLE FORMULA DETERMINING WATER REQUIREMENTS FOR SETTLING WATER DISPUTES, W69-10211	06D
BASALTS EFFECT OF TECTONIC STRUCTURE ON THE OCCURRENCE OF GROUND WATER IN THE BASALT OF THE COLUMBIA RIVER GROUP OF THE DALLAS AREA, OREGON AND WASHINGTON, W69-10107	02F	BLEACHING WASTES WASTE TREATMENT AT CANNON MILLS, W69-10282	05D
BAYS OBSERVATIONS OF GASES IN CHESAPEAKE BAY SEDIMENTS, W69-09900	02K	BLEACHERY AND DYEHOUSE WASTE STUDIES, W69-10283	05D
BED LOAD RESISTANCE TO REVERSING FLOWS OVER MOVABLE BEDS, W69-09892	02E	BLEACHERY WASTES TREATED BY NUTRIENTS AND HIGH-RATE FILTER PLANT. W69-10289	05D
BEDS LANDS IN OHIO RIVER BED. W69-09890	06E	BLOCK-RECURSIVE MODELS SIMULATION OF ECONOMIC SYSTEMS, W69-09949	06A
BENEFICIAL USE CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS, W69-09979	06E	BOATING ECONOMIC ASPECTS OF PRIVATELY OWNED FISHING ENTERPRISES IN WISCONSIN, W69-10191	06D
BENTHIC FLORA A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND. W69-10150	02L	BOATING REGULATIONS OPERATION OF WATERCRAFT. W69-10230	06E
THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOTOSYNTHESIS, AND MACROMOLECULES IN BENTHIC ALGAL MATS, W69-10151	05C	BOATS MUNICIPAL BRIDGES, FERRIES, AND TERMINALS. W69-10050	06E
BIBLIOGRAPHIES SELECTED URBAN STORM WATER RUNOFF ABSTRACTS. W69-10085	04C	OPERATION OF WATERCRAFT. W69-10230	06E
BIOCHEMICAL OXYGEN DEMAND ECONOMIC EVALUATION OF FLOW AUGMENTATION A SYSTEMS		RAILROAD COMPANY MAY OPERATE FERRY. W69-10249	06E
		BOG FORMATION RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA, W69-10172	02K
		BOGS RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA, W69-10172	02K
		BOTTOM SEDIMENTS INVESTIGATION OF WATER RESERVOIR BOTTOM DENSITY USING RADIOMETRIC METHODS (POLISH), W69-10109	02J

THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS. W69-10121	02K	CARBON FIXATION EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO. W69-10158	05C
BOUNDARIES(PROPERTY) SALE OF ISLANDS. W69-10073	06E	CARBON RADIOISOTOPES A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND. W69-10150	02L
NAVIGABLE WATERCOURSES AS FENCES. W69-10077	06E	SELF-ABSORPTION OF C-14 RADIATION IN FRESHWATER OSTRACODS. W69-10166	02H
STREAM CAVING AND ROAD CONSTRUCTION. W69-10299	04C	TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD. W69-10181	02H
BRAZIL HYDROGEOLGY OF THE UPPER CABIBARIBE BASIN PERNAMBUCO, BRAZIL A RECONNAISSANCE IN AN AREA OF CRYSTALLINE ROCKS, W69-10145	02F	CARBOXYMETHYLCELLULOSE CMC KAYOED STREAM POLLUTION. W69-10287	05D
BREWERY WASTES AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH). W69-10088	05D	CASINGS EVALUATION AND CONTROL OF CORROSION AND ENCRUSTATION IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN. W69-09910	08G
BRIDGES MUNICIPAL BRIDGES, FERRIES, AND TERMINALS. W69-10050	06E	CATIONS RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA. W69-10172	02K
STATE HIGHWAYS. W69-10051	06E	CENTRAL PLANNING ECONOMICS AND THE ADMINISTRATION OF NATIONAL PLANNING. W69-09978	06B
BRIDGES. W69-10056	06E	CHANNEL ENCROACHMENT STATE REGULATION OF CHANNEL ENCROACHMENTS. W69-10207	06E
DRAINS, CULVERTS, AND BRIDGES AS PART OF THE STATE HIGHWAY. W69-10179	04A	CHANNELS ILLINOIS WATERWAY. W69-10044	06E
BRINES MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING BRINES, THE SABKHA, TRUCIAL COAST, ARABIAN GULF, W69-09906	02L	CHAPARRAL STREAMFLOW RECORDS FROM THE SAN DIMAS EXPERIMENTAL FOREST, 1939-1959. W69-09990	02E
EFFECT OF DYE ON SOLAR EVAPORATION OF BRINE, W69-09923	02D	CHECK STRUCTURES FLOOD CONTROL. W69-10072	06E
BUDGETING SOME NOTES ON THE LINDAHL THEORY OF DETERMINATION OF PUBLIC EXPENDITURES, W69-09951	06B	CHEMICAL ANALYSIS ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS. W69-10120	02K
CAPITAL BUDGETING OF INTERRELATED PROJECTS SURVEY AND SYNTHESIS. W69-09971	06A	CHEMICAL LIMNOLOGY ON CONTROL OF LAKE EUTROPHICATION EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS--(IN GERMAN). W69-10164	05C
BULKHEAD LINE WHARF LINES AND BULKHEADS. W69-10033	06E	CHEMICAL PRECIPITATION TREATMENT OF WOOL SCOUR EFFLUENT AND THE RECOVERY OF WOOL GREASE. W69-10266	05D
BULKHEADS WATERWAYS AND MILLDAMS. W69-10008	06E	CHEMICAL PROCESSES REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA. W69-10176	05G
BURNING AGENTS CHEMICAL TREATMENT OF OIL SLICKS, A STATUS REPORT ON THE USE OF CHEMICALS AND OTHER MATERIALS TO TREAT OIL SPILLED ON WATER. W69-10252	05D	CHEMICAL REACTION ENGINEERING OXYGENATION OF IRON(II) IN CONTINUOUS REACTORS. W69-10293	05D
CALIFORNIA ARTIFICIAL DESTRATIFICATION IN RESERVOIRS OF THE CALIFORNIA STATE WATER PROJECT, W69-09883	05C	CHEMICAL REACTIONS EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS--2. APPLICATIONS. W69-10092	01B
INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS, W69-09932	07B	CHEMICAL WASTES WATER AND WASTES SYSTEM FOR AN 'INSTANT FACTORY'. W69-10279	05D
FLOODS OF JANUARY AND FEBRUARY 1969 IN CENTRAL AND SOUTHERN CALIFORNIA, W69-10089	02E	CHLORINATION PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES. W69-10171	05F
LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA, W69-10135	04B	CHLOROPHYLL THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHORYLATION, AND MACROMOLECULES IN BENTHIC ALGAL MATS. W69-10151	05C
CANADA COMPARISONS IN RESOURCE MANAGEMENT. W69-09952	06B	CHYDORIDAE EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY. W69-10149	02H
CANALS ILLINOIS AND MISSISSIPPI CANAL-STATE PARK. W69-10045	06E	CITIES POWER TO ACQUIRE AND DISPOSE OF PROPERTY RESTRICTIONS AS TO DISPOSITION OF WATER FRONT. W69-09889	06E
LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA, W69-10135	04B		
CAPITAL CAPITAL BUDGETING OF INTERRELATED PROJECTS SURVEY AND SYNTHESIS. W69-09971	06A		
DISCRETE DYNAMIC PROGRAMMING AND CAPITAL ALLOCATION, W69-10017	06C		
CAPITAL BUDGETING CAPITAL BUDGETING OF INTERRELATED PROJECTS SURVEY AND SYNTHESIS. W69-09971	06A		

		SUBJECT INDEX	CIT-COM
POWER TO ACQUIRE PIERS AND BEACHES. W69-10046	06E	COMPARISON BETWEEN ANALOG AND DIGITAL SIMULATION TECHNIQUES FOR AQUIFER EVALUATION. W69-09931	07C
LEVEE IMPROVEMENT COMMISSION. W69-10047	06E	HYDROLOGIC DISTRIBUTIONS RESULTING FROM MIXED POPULATIONS AND THEIR COMPUTER SIMULATION. W69-09935	07C
MUNICIPAL BRIDGES, FERRIES, AND TERMINALS. W69-10050	06E	SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE. W69-10292	06A
WATER RECREATIONAL AREAS. W69-10055	06E	COMPUTER PROGRAMS PROCESSING OF DIGITAL DATA LOGGER STD TAPES AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AND THE BUREAU OF COMMERCIAL FISHERIES, LA JOLLA, CALIFORNIA. W69-09894	07C
BRIDGES. W69-10056	06E	INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS. W69-10098	02A
SKAFF V SIOUX CITY (UNREASONABLE DELAY IN CONDEMNATION PROCEEDINGS). W69-10241	04A	COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS. W69-10213	07A
POWER TO ACQUIRE PIERS AND BEACHES. W69-10248	04A	CONDEMNATION 6816.5 ACRES OF LAND V UNITED STATES (VALUATION OF PROPERTY IN CONDEMNATION PROCEEDING). W69-09907	06E
LOCATING SOURCE OF WATER SUPPLY OUTSIDE OF MUNICIPALITIES. W69-10251	04A	WATERCOURSES AND CUTS GENERALLY. W69-10041	06E
CITY PLANNING DOCKS. W69-10232	04A	EMINENT DOMAIN. W69-10052	06E
CLADOCERA EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY. W69-10149	02H	SKAFF V SIOUX CITY (UNREASONABLE DELAY IN CONDEMNATION PROCEEDINGS). W69-10241	04A
CLASSIFICATION WATER POLLUTION AND DISPOSAL OF WASTES. W69-10038	05B	CONDEMNATION VALUE 6816.5 ACRES OF LAND V UNITED STATES (VALUATION OF PROPERTY IN CONDEMNATION PROCEEDING). W69-09907	06E
CLOUD COVER RECORDED OBSERVATIONS ON THE INFLUENCE OF CLOUDINESS AND WIND VELOCITY ON THE BRIGHTNESS OF THE DAYLIGHT SKY ABOVE THE WATER SPACE (RUSSIAN). W69-09899	02B	WATERCOURSES AND CUTS GENERALLY. W69-10041	06E
COLLECTIVE CONSUMPTION RESOURCE ALLOCATION WITH PROBABILISTIC INDIVIDUAL PREFERENCES. W69-09956	06C	UNITED STATES V 930.65 ACRES OF LAND IN JEFFERSON COUNTY (VALUATION OF LAND WITHOUT WATER SUPPLY). W69-10058	06E
COLLECTIVE PROVISION PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION. W69-09958	06C	BRADSHAW V STATE HIGHWAY COMM'R (REQUIREMENT OF LANDOWNERS TO MITIGATE CONDEMNATION DAMAGES). W69-10237	04C
COLLECTIVE-GOOD COLLECTIVE-CONSUMPTION SERVICES OF INDIVIDUAL-CONSUMPTION GOODS. W69-09974	06C	CONJUNCTIVE USE CONJUNCTIVE USE OF GROUND AND SURFACE WATERS. W69-10012	06A
COLORADO EPIDEMIC GIARDIASIS AT A SKI RESORT. W69-10079	05C	CONNECTICUT BLOOM V WATER RESOURCES COMMISSION (RELATIVE RIGHTS OF OWNERS OF ADJACENT UPLANDS). W69-10240	04A
WATER-LEVEL CHANGES 1964-1968, NORTHERN HIGH PLAINS OF COLORADO. W69-10094	02F	CONSERVATION COMPARISONS IN RESOURCE MANAGEMENT. W69-09952	06B
FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO MOUNTAIN LAKES. W69-10154	02H	THE FRESH WATER OF NEW YORK STATE ITS CONSERVATION AND USE. W69-09969	06B
COLUMBIA RIVER TREATY THE COLUMBIA RIVER TREATY AND PROTOCOL AGREEMENT. W69-10209	06E	STATE CONSERVATION COMMISSION. W69-10053	06E
COMBINED SEWER OVERFLOWS STRAINER/FILTER TREATMENT OF COMBINED SEWER OVERFLOWS. W69-10254	05D	FISH. W69-10227	06E
COMPARATIVE MORPHOLOGY EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY. W69-10149	02H	CONSTRUCTION ILLINOIS WATERWAY. W69-10044	06E
COMPARATIVE STUDIES EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY. W69-10149	02H	BRIDGES. W69-10056	06E
COMPENSATION 6816.5 ACRES OF LAND V UNITED STATES (VALUATION OF PROPERTY IN CONDEMNATION PROCEEDING). W69-09907	06E	DOCKS. W69-10232	04A
RESOURCE ALLOCATION WITH PROBABILISTIC INDIVIDUAL PREFERENCES. W69-09956	06C	CONSUMPTIVE USE DETERMINING WATER REQUIREMENTS FOR SETTLING WATER DISPUTES. W69-10211	06D
COMPRESSIVE WAVE VELOCITY(PERMAFROST) VELOCITY OF COMPRESSIVE WAVES IN POROUS MEDIA AT PERMAFROST TEMPERATURES. W69-10138	02C	CONTINENTAL SHELF ARAGONITE-CEMENTED SANDSTONE FROM OUTER CONTINENTAL SHELF OFF DELAWARE BAY SUBMARINE LITHIFICATION MECHANISM YIELDS PRODUCT RESEMBLING BEACHROCK. W69-09908	02L
COMPUTER MODELS NUMERICAL SIMULATION OF WAVE-CREST MOVEMENT IN RIVERS AND ESTUARIES. W69-09919	02E	CONTRACTS STATE AID IN FLOOD CONTROL MUNICIPAL-FEDERAL FLOOD CONTROL PROJECTS. W69-10048	06E
		WATER RESOURCES RESEARCH CATALOG, VOLUME FOUR. W69-10115	10
		STATE AID IN FLOOD CONTROL MUNICIPAL-FEDERAL FLOOD CONTROL PROJECTS. W69-10250	04A
		CONVECTION VISCOUS DISSIPATION IN EXTERNAL NATURAL CONVECTION FLOWS.	

W69-10091	01A	DAMS.	06E
CONVERSION TABLES A TABLE FOR CONVERTING PH TO HYDROGEN ION CONCENTRATION (HC) OVER THE RANGE 5-9, W69-10148	02K	W69-10027	06E
COPPER APPLICATION METHODS ALGAE CONTROL WITH COPPER SULFATE, W69-10157	05G	WATER POWER COMPANIES.	06E
COPPER DOSAGE ALGAE CONTROL WITH COPPER SULFATE, W69-10157	05G	DETERMINATION OF DYNAMIC PRESSURE OF WATER ON A DAM USING THE EHDA METHOD AND TAKING INTO CONSIDERATION THE DAM ELASTICITY (RUSSIAN), W69-10099	08B
COPPER SULFATE COPPER SULPHATE AIR SPRAY CURES LAKE ALGAE PROBLEM, W69-10155	05G	ERETION AND INSPECTION OF DAMS.	04A
ALGAE CONTROL WITH COPPER SULFATE, W69-10157	05G	W69-10223	04A
CORPS OF ENGINEERS ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES, W69-09983	06B	DAMAGES	
CORROSION EVALUATION AND CONTROL OF CORROSION AND ENCRUSTATION IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN, W69-09910	08G	SKAFF V SIOUX CITY (UNREASONABLE DELAY IN CONDEMNATION PROCEEDINGS). W69-10241	04A
COST COMPARISONS CHEMICAL PURIFICATION OF VARIOUS INDUSTRIAL WASTE WATERS (IN GERMAN), W69-10280	05D	DAMS	
COSTS A PUBLIC CHOICE APPROACH TO PUBLIC UTILITY PRICING, W69-09962	06C	DAMS.	
COST-BENEFIT ANALYSIS CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS, W69-09980	06B	W69-10027	06E
PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS, W69-10011	06A	WATER CONSERVATION COMMISSION.	06E
COTTON DISPOSAL OF COMBINED TEXTILE FINISHING WASTES AND DOMESTIC SEWAGE, W69-10288	05D	W69-10068	06E
CREST-STAGE STATIONS SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958- SEPT 1967), W69-10093	02E	ERETION AND INSPECTION OF DAMS.	04A
CRITICAL PATH METHOD CALENDAR - DAY C P M., W69-10009	06A	W69-10223	04A
CRITICAL TEMPERATURES ALGAE CONTROL WITH COPPER SULFATE, W69-10157	05G	DAMSITES	
CROSS CONNECTIONS LEGAL ASPECTS OF CROSS CONNECTION INSPECTIONS, W69-10060	06E	GEOLGY OF PROPOSED POWERSITES AT DEER LAKE AND KASNYKU LAKE, BARANOF ISLAND, SOUTHEASTERN ALASKA, W69-09911	08E
CROSSINGS CROSSING OF STREAMS BY RAILROADS. W69-10175	06E	DAPHNIA	
CROSS-SPECTRAL ANALYSIS THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES, W69-09938	06A	QUANTITATIVE RELATIONS OF THE FEEDING AND GROWTH OF DAPHNIA PULEX OBTUSA (KURZ) SCOURFIELD, W69-10152	05C
CRUSTACEA EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY, W69-10149	02H	DAPHNIA PULEX OBTUSA QUANTITATIVE RELATIONS OF THE FEEDING AND GROWTH OF DAPHNIA PULEX OBTUSA (KURZ) SCOURFIELD, W69-10152	05C
CULVERTS DRAINS, CULVERTS, AND BRIDGES AS PART OF THE STATE HIGHWAY. W69-10179	04A	DATA COLLECTIONS	
CURRENT METERS DISCHARGE MEASUREMENTS AT GAGING STATIONS, W69-10111	07B	BASIC DATA REPORT NO 3 FOR RESEARCH ON FLOOD FREQUENCY FOR SMALL DRAINAGE AREAS, W69-09895	02E
CURRENTS(WATER) RESISTANCE TO REVERSING FLOWS OVER MOVABLE BEDS, W69-09892	02E	WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN, W69-09947	05G
CYCLING NUTRIENTS CHANGE IN DISTRIBUTION AND AVAILABILITY OF NITROGEN, WITH FOREST SUCCESSION ON NORTH SLOPES IN INTERIOR ALASKA, W69-10173	02K	GROUND-WATER LEVELS IN IDAHO, 1969, W69-10081	02F
CZECHOSLOVAKIA FLUORINE IN THE REGIONALLY METAMORPHOSED SKARNS OF THE CZECH MASSIF (CZECHOSLOVAKIAN), W69-10123	02K	FLOODS OF JANUARY AND FEBRUARY 1969 IN CENTRAL AND SOUTHERN CALIFORNIA, W69-10089	02E
DAM CONSTRUCTION WATERWAYS AND MILLDAMS. W69-10008	06E	SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958- SEPT 1967), W69-10093	02E
DATA PROCESSING PROCESSING OF DIGITAL DATA LOGGER STD TAPES AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AND THE BUREAU OF COMMERCIAL FISHERIES, LA JOLLA, CALIFORNIA, W69-09894	07C	SURFACE-WATER DISCHARGE AND GROUND-WATER LEVELS IN THE EAST FORK RIVER AREA, SUBLLETTE COUNTY, WYOMING, W69-10097	02E
COMPUTER TECHNOLOGY IN EVAPORATION STUDIES, W69-09930	02D	WATER RECORDS OF PUERTO RICO, 1958-63, W69-10134	02E
COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS, W69-10213	07A	SUMMARY OF HYDROLOGIC AND PHYSICAL PROPERTIES OF ROCK AND SOIL MATERIALS, AS ANALYZED BY THE HYDROLOGIC LABORATORY OF THE U.S. GEOLOGICAL SURVEY, 1948-60, W69-10143	02J
DATA STORAGE AND RETRIEVAL COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS, W69-10213	07A	DATA PROCESSING	
DEBT MANAGEMENT SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL BORROWING, W69-09976	06A	COMPUTER TECHNOLOGY IN EVAPORATION STUDIES, W69-09930	02D
DECISION MAKING PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS, W69-10011	06A	COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS, W69-10213	07A
DYNAMIC INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10014	06A	DATA STORAGE AND RETRIEVAL	
ADVOCACY AND RESOURCE ALLOCATION DECISIONS IN THE PUBLIC SECTOR, W69-10203	06B	DEBT MANAGEMENT	
DECISION-MAKING ACTIVITY ANALYSIS IN WATER PLANNING, W69-09982	06B	SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL BORROWING,	

A FRAMEWORK FOR DEALING WITH THE URBAN ENVIRONMENT INTRODUCTORY STATEMENT, W69-10206	06B	DISCHARGE MEASUREMENT IN OPEN CHANNELS BY DILUTION METHODS (FRENCH), W69-09905	07B
DECREASING-COSTS A PUBLIC CHOICE APPROACH TO PUBLIC UTILITY PRICING, W69-09962	06C	METHOD OF DETERMINING THE DISCHARGE OF TWO-LEVEL SPILLWAYS, W69-10129	08B
DELAWARE THE AVAILABILITY OF GROUNDWATER FROM THE POTOMAC FORMATION IN THE CHESAPEAKE AND DELAWARE CANAL AREA, DELAWARE, W69-09942	02F	DISCRIMINANT ANALYSIS ON THE INTERPRETATION OF DISCRIMINANT ANALYSIS, W69-09957	06A
WHARF LINES AND BULKHEADS. W69-10033	06E	DISPERSANTS CHEMICAL TREATMENT OF OIL SLICKS, A STATUS REPORT ON THE USE OF CHEMICALS AND OTHER MATERIALS TO TREAT OIL SPILLED ON WATER. W69-10252	05D
DEMAND COLLECTIVE-CONSUMPTION SERVICES OF INDIVIDUAL-CONSUMPTION GOODS, W69-09974	06C	DISPERSION DISPERSION OF FLOATING PARTICLES IN UNIFORM CHANNEL FLOW, W69-09887	02J
DENMARK SEDIMENTS FROM DANISH LAKES, W69-10174	02H	LONGITUDINAL DISPERSION IN OPEN CHANNELS, W69-09888	02E
DENSITY INVESTIGATION OF WATER RESERVOIR BOTTOM DENSITY USING RADIONUCLIC METHODS (POLISH), W69-10109	02J	DISSOLVED OXYGEN THE RANGE OF CHOICE IN WATER MANAGEMENT, W69-09964	05G
DEPOSITION(SEDIMENTS) MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING BBINES, THE SABKA, TRUCIAL COAST, ARABIAN GULF, W69-09906	02L	ALGAL RESPIRATION IN A EUTROPHIC ENVIRONMENT, W69-10159	05B
DEPT MEETING STATE RESPONSIBILITY IN WATER RESOURCES DEVELOPMENT, W69-10194	06B	ECONOMIC EVALUATION OF FLOW AUGMENTATION A SYSTEMS ANALYSIS CASE STUDY, W69-10190	05G
DESIGN CRITERIA OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN, W69-10021	05G	DISSOLVED SOLIDS DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER, W69-10125	02K
DESIZING WASTES SIMPLE BIO-AERATION KILLS STRONG WASTES CHEAPLY. W69-10276	05G	ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES, W69-10133	02K
WASTE-TREATMENT EXPERIENCE REPORTED, W69-10281	05D	DISTRIBUTION THE RELATIONSHIP OF THE DISTRIBUTION OF THE DIATOM SKELETONEMA TROPICUM TO TEMPERATURE, W69-10162	05C
WASTE TREATMENT AT CANNON MILLS, W69-10282	05D	DISTRIBUTION PATTERNS A NOTE ON THE PARTITIONING OF A SINGLE PRODUCT MARKET INTO TERRITORIES OF OUTLETS, W69-09955	06B
CNC KAYOED STREAM POLLUTION. W69-10287	05D	DISTRIBUTION SYSTEMS IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS, W69-10019	02F
DESTRATIFICATION CHEMISTRY OF N AND MN IN COX HOLLOW LAKE, W69-09881	05A	LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK METROPOLITAN REGION, W69-10023	06A
DETERGENTS UNION CARBIDE'S BIODEGRADABLE SURFACTANTS FIGHT POLLUTION. W69-10262	05G	DISTRICT OF COLUMBIA WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN THE DISTRICT OF COLUMBIA. W69-10102	04A
DETERMINATION OF THE DEGRADABILITY OF SYNTHETIC DETERGENTS, W69-10285	05D	DIVERSION EMINENT DOMAIN. W69-10052	06E
DIATOMS A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND, W69-10150	02L	DAVIS V CAHOON (DIVERSION OF NATURAL FLOW BY LOWER LANDOWNER PROHIBITED). W69-10239	04A
THE RELATIONSHIP OF THE DISTRIBUTION OF THE DIATOM SKELETONEMA TROPICUM TO TEMPERATURE, W69-10162	05C	DOCKS WHARF LINES AND BULKHEADS. W69-10033	06E
DIFFUSION DISPERSION OF FLOATING PARTICLES IN UNIFORM CHANNEL FLOW, W69-09887	02J	DOCKS. W69-10232	04A
DIGITAL COMPUTERS NUMERICAL SIMULATION OF WAVE-CREST MOVEMENT IN RIVERS AND ESTUARIES, W69-09919	02E	DOMESTIC WASTE WASTE TREATMENT AT CANNON MILLS, W69-10282	05D
COMPUTER TECHNOLOGY IN EVAPORATION STUDIES, W69-09930	02D	DOMESTIC WASTES WATER AND WASTES SYSTEM FOR AN 'INSTANT FACTORY'. W69-10279	05D
COMPARISON BETWEEN ANALOG AND DIGITAL SIMULATION TECHNIQUES FOR AQUIFER EVALUATION, W69-09931	07C	BLEACHERY AND DYEHOUSE WASTE STUDIES, W69-10283	05D
IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL, W69-09936	06A.	DOMESTIC WATER FUTURE SUPPLIES OF WATER FOR DOMESTIC USE. W69-10039	06E
USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW PROBLEMS IN AQUIFER SYSTEMS, W69-09937	07C	DRAINAGE GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECESSION IN THE NARVIKSKJOMEN DISTRICT, NORWAY, W69-09924	02C
DISCHARGE MEASUREMENT DISCHARGE MEASUREMENT IN OPEN CHANNELS BY DILUTION METHODS (FRENCH), W69-09905	07B	DRAINAGE OF ROADBED. W69-09945	06E
DISCHARGE MEASUREMENTS AT GAGING STATIONS, W69-10111	07B	WATER SUPPLY, DRAINAGE AND FLOOD CONTROL. W69-10057	06E
DISCHARGE(WATER)		EMINENT DOMAIN. W69-10185	04A
		DRAINAGE OF LOW LANDS.	

W69-10225	04A	EVOLUTION AND ADAPTIVE RADIATION IN THE CHITONIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY.
RUBIN V W. H. HINMAN, INC. (STATE DRAINAGE EASEMENTS).	04A	W69-10149
W69-10226		02R
WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA.		
W69-10294	03F	
DRAINAGE DISTRICTS		
WATER DRAINAGE AND LEVEE DISTRICTS.		
W69-10061	06E	ECONOMIC ANALYSIS
W69-10062	06E	ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION.
W69-10063	06E	W69-09972
W69-10064	06E	06A
ARKANSAS IRRIGATION, DRAINAGE AND WATERSHED IMPROVEMENT DISTRICT ACT OF 1949.		ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT.
W69-10065	06E	W69-09973
IMPROVEMENT DISTRICTS OF RIVER WATER - DRAINAGE AND LEVEE DISTRICTS.		06B
W69-10066	06E	REGIONAL ECONOMICS A SURVEY.
LEVEE AND DRAINAGE DISTRICTS.		W69-09975
W69-10233	04A	06B
DRAINAGE EASEMENTS		ECONOMIC DEVELOPMENT
RUBIN V W. H. HINMAN, INC. (STATE DRAINAGE EASEMENTS).		ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT.
W69-10226	04A	W69-09973
DRAINAGE SYSTEMS		06B
PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS.		REGIONAL ECONOMICS A SURVEY.
W69-10011	06A	W69-09975
LEVEE AND DRAINAGE DISTRICTS.		ECONOMIC IMPACT
W69-10233	04A	THE ECONOMICS OF WATER TRANSFER.
DAVIS V CAHOON (DIVERSION OF NATURAL FLOW BY LOWER LANDOWNER PROHIBITED).		W69-10208
W69-10239	04A	06B
DRAINS		ECONOMIC PREDICTION
DRAINS, CULVERTS, AND BRIDGES AS PART OF THE STATE HIGHWAY.		DYNAMIC INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS).
W69-10179	04A	W69-10014
DRILLING		06A
ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION.		ECONOMIC SYSTEMS
W69-09927	08E	SIMULATION OF ECONOMIC SYSTEMS.
DROUGHTS		W69-09949
METEOROLOGICAL AND HYDROLOGICAL DROUGHT IN RARITAN RIVER BASIN IN NEW JERSEY.		06A
W69-10184	02A	ECONOMICS
THE RECENT 5-YEAR DROUGHT ON SCITUATE WATERSHED AND NEARBY DRAINAGE BASINS IN RHODE ISLAND AND MASSACHUSETTS.		REGIONAL ECONOMICS A SURVEY.
W69-10188	02E	W69-09975
DYE RELEASES		ECONOMICS AND THE ADMINISTRATION OF NATIONAL PLANNING.
MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS.		W69-09978
W69-09914	05B	06B
DYEING WASTES		ECONOMIC EVALUATION OF WATER PART 6, A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY.
BLEACHERY AND DYEHOUSE WASTE STUDIES.		W69-10087
W69-10283	05D	06B
DYNAMIC PROGRAMMING		EFFICIENCIES
THE INTERREGIONAL DYNAMIC INPUT-OUTPUT PROGRAMMING MODEL.		ACTIVITY ANALYSIS IN WATER PLANNING.
W69-10015	06B	W69-09982
ECONOMIC EVALUATION OF WATER PART VI A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY.		06B
W69-10016	06A	EFFICIENCY
DISCRETE DYNAMIC PROGRAMMING AND CAPITAL ALLOCATION.		ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES.
W69-10017	06C	W69-09983
OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN.		06B
W69-10021	05G	EFFLUENT CHARGES
OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS.		COMMENT ON ECONOMY OF WATER QUALITY MANAGEMENT AND POLLUTION CONTROL.
W69-10024	05B	W69-09965
DYNAMICS		05G
ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION.		EFFLUENT TREATMENT
W69-09927	08E	WATER POLLUTION (IN FRENCH).
DETERMINATION OF DYNAMIC PRESSURE OF WATER ON A DAM USING THE EHD METHOD AND TAKING INTO CONSIDERATION THE DAM ELASTICITY (RUSSIAN).		W69-10270
W69-10099	08B	05D
EASEMENTS		EFFLUENTS
RUBIN V W. H. HINMAN, INC. (STATE DRAINAGE EASEMENTS).		FACTORS AFFECTING RECOVERY OF WAX FROM WOOL SCOURING LIQUORS.
W69-10226	04A	W69-10284
EASTERN ALPS		05G
TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD.		ELASTICITY (MECHANICAL)
W69-10181	02H	VELOCITY OF COMPRESSIVE WAVES IN POROUS MEDIA AT PERMAFROST TEMPERATURES.
ECOLOGY		W69-10138
RUBIN V W. H. HINMAN, INC. (STATE DRAINAGE EASEMENTS).		02C
W69-10075		ELECTRIC POWER PRODUCTION
W69-10069		WATER POWER COMPANIES.
W69-10069		06E
ELEMENTS (CHEMICAL)		ELEPHANT BUTTE RESERVOIR (IN MEX)
ASPECTS OF THE OCCURRENCE AND MIGRATION OF NIOBium, BERYLLIUM, AND RARE EARTHS IN NATURAL ALKALINE WATERS.		EVAPORATION INVESTIGATIONS AT ELEPHANT BUTTE RESERVOIR IN NEW MEXICO.
W69-10116		W69-09934
EMINENT DOMAIN		02D
POWER TO ACQUIRE PIERS AND BEACHES.		W69-10046
W69-10046		06E
EMINENT DOMAIN.		EMINENT DOMAIN.
W69-10052		W69-10052
UNITED STATES V 930.65 ACRES OF LAND IN JEFFERSON COUNTY (VALUATION OF LAND WITHOUT WATER SUPPLY).		06E
W69-10058		W69-10058
PACKET AND NAVIGATION COMPANIES--COAL AND STONE COMPANIES.		PACKET AND NAVIGATION COMPANIES--COAL AND STONE COMPANIES.
W69-10075		W69-10075
EMINENT DOMAIN.		06E
W69-10185		EMINENT DOMAIN.
RUBIN V W. H. HINMAN, INC. (STATE DRAINAGE EASEMENTS).		04A

W69-10226	0NA	
BRADSHAW V STATE HIGHWAY COMM'S (REQUIREMENT OF LANDOWNERS TO MITIGATE CONDEMNATION DAMAGES).		ALGAL RESPIRATION IN A EUTROPHIC ENVIRONMENT, W69-10159 05B
W69-10237	04C	
POWER TO ACQUIRE PIERS AND BEACHES.		ON CONTROL OF LAKE EUTROPHICATION EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS--(IN GERMAN), W69-10164 05C
W69-10248	04A	
LOCATING SOURCE OF WATER SUPPLY OUTSIDE OF MUNICIPALITIES.		ALGAE AND PHOSPHORUS IN LAKE MINNETONKA, W69-10167 05C
W69-10251	04A	
ENERGY		ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON, W69-10169 05C
THE FRESH WATER OF NEW YORK STATE ITS CONSERVATION AND USE.		EUTROPHICATION OF LAKES AND RIVERS ITS ORIGIN AND PREVENTION (IN GERMAN), W69-10170 05C
W69-09969	06B	
ENFORCEMENT		EXCESSIVE WATER FERTILIZATION, W69-10178 05C
SEWAGE DISPOSAL SYSTEMS ON ISLANDS.		EVALUATION
W69-10034	06E	MODIFICATIONS AND EVALUATING OF THE EVAPOTRANSPIRATION TENT, W69-09984 02D
ENGINEERING GEOLOGY		COMPARATIVE ESTIMATE OF METHODS OF COMPUTING EVAPORATION FROM BODIES OF WATER, W69-10131 02D
PERMAFROST AND RELATED ENGINEERING PROBLEMS IN ALASKA,		EVAPORATION
W69-10106	02C	INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR, W69-09920 02D
ENVIRONMENTAL EFFECTS		DETERMINATION OF THE SEASONAL AND MONTHLY EVAPORATION NORMALS FROM AGRICULTURAL FIELDS FROM OBSERVATIONS AT A NETWORK OF STATIONS, W69-09921 02D
EFFECTS OF SURFACE MINING ON THE FISH AND WILDLIFE RESOURCES OF THE UNITED STATES,		EFFECT OF DYE ON SOLAR EVAPORATION OF BRINE, W69-09923 02D
W69-10137	05C	COMPUTER TECHNOLOGY IN EVAPORATION STUDIES, W69-09930 02D
STUDIES ON MORPHOGENESIS IN A BLUE-GREEN ALGA. I. EFFECT OF INORGANIC NITROGEN SOURCES ON DEVELOPMENTAL MORPHOLOGY OF ANABENA DOLIOLUM.		EVAPORATION INVESTIGATIONS AT ELEPHANT BUTTE RESERVOIR IN NEW MEXICO, W69-09934 02D
W69-10177	05C	SNOW EVAPORATION REDUCTION MIGRATION OF EVAPORATION SUPPRESSANTS THROUGH SNOW, W69-09933 07B
ENVIRONMENTAL ENGINEERING		COMPARATIVE ESTIMATE OF METHODS OF COMPUTING EVAPORATION FROM BODIES OF WATER, W69-10131 02D
WATER POLLUTION AND DISPOSAL OF WASTES.		EVAPORATION CONTROL
W69-10036	05B	SNOW EVAPORATION REDUCTION MIGRATION OF EVAPORATION SUPPRESSANTS THROUGH SNOW, W69-09933 07B
ENVIRONMENTAL SANITATION		EVAPORITE DEPOSITION
INTERSTATE WATER SANITATION BOARD.		MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING BRINES, THE SABKHA, TRUCIAL COAST, ARABIAN GULF, W69-09906 02L
W69-10297	05G	
EPIDEMICS		EVAPOTRANSPIRATION
EPIDEMIC GIARDIASIS AT A SKI RESORT,		INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR, W69-09920 02D
W69-10079	05C	
EPIDEMIOLOGY		DETERMINATION OF THE SEASONAL AND MONTHLY EVAPORATION NORMALS FROM AGRICULTURAL FIELDS FROM OBSERVATIONS AT A NETWORK OF STATIONS, W69-09921 02D
EPIDEMIC GIARDIASIS AT A SKI RESORT,		MODIFICATIONS AND EVALUATING OF THE EVAPOTRANSPIRATION TENT, W69-09984 02D
W69-10079	05C	
EQUILIBRIUM		REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE- LEHIGH EXPERIMENTAL FOREST, W69-10005 02A
URANIUM DISEQUILIBRIUM IN GROUNDWATER AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS,		TECHNIQUES IN GRASSLAND WATERSHED RESEARCH, W69-10007 02A
W69-09925	02K	
EQUIPMENT		ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES, 1967, W69-10126 03B
FLOW MEASURING STRUCTURES IN THE HYDROLOGICAL OBSERVATION NETWORK,		WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER, W69-10136 02D
W69-09929	02E	
ERIE(PA)		EVAPOTRANSPIRATION CONTROL
JOINT MUNICIPAL AND SEMICHEMICAL PULPING WASTE TREATMENT, A PILOT STUDY EVALUATING COMBINED TREATMENT OF DOMESTIC SEWAGE AND WASTE SEMICHEMICAL PULPING AND PAPERMAKING WASTES.		ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES, 1967, W69-10126 03B
W69-10253	05D	
EROSION		EVOLUTION
SEDIMENT--ITS CONSEQUENCES AND CONTROL,		EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY, W69-10149 02H
W69-10003	02J	
EROSION CONTROL		EXCRETION
LEACHABILITY OF A WETTING-AGENT TREATMENT FOR WATER- RESISTANT SOILS,		EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO, W69-10158 05C
W69-09989	02G	
ESSEX COUNTY(NJ)		
GROUND-WATER RESOURCES OF ESSEX COUNTY, NEW JERSEY,		
W69-09933	02F	
ESTUARIES		
STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES,		
W69-09879	05B	
OBSERVATIONS OF GASES IN CHESAPEAKE BAY SEDIMENTS,		
W69-09900	02K	
FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY,		
W69-09901	02L	
MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS,		
W69-09914	05B	
OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS,		
W69-10024	05B	
ESTUARINE ENVIRONMENT		
FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY,		
W69-09901	02L	
ET TENT		
MODIFICATIONS AND EVALUATING OF THE EVAPOTRANSPIRATION TENT,		
W69-09986	02D	
EUTROPHICATION		
CHANGES IN WESTERN LAKE ERIE DURING THE PERIOD 1948-1962,		
W69-10156	02H	

EXPECTED UTILITY
TAXATION AND RISK-TAKING AN EXPECTED UTILITY APPROACH,
W69-09963 06B

EXPERIMENTAL LIMNOLOGY
FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO
MOUNTAIN LAKES.
W69-10154 02H

EXPERIMENTAL WATERSHEDS
REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE-
LEHIGH EXPERIMENTAL FOREST,
W69-10005 02A

TECHNIQUES IN GRASSLAND WATERSHED RESEARCH,
W69-10007 02A

EXTERNALITIES
PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND
GOVERNMENT ACTION,
W69-09958 06C

EXTRACELLULAR PRODUCTION
EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR
PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE
ONTARIO,
W69-10158 05C

EXTRACELLULAR PRODUCTS
THE IMPORTANCE OF EXTRACELLULAR PRODUCTS OF ALGAE IN
FRESHWATER,
W69-10180 05C

FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY
RESEARCH ON NATURAL RESOURCES A REVIEW AND COMMENTARY,
W69-10210 06D

FEDERAL GOVERNMENT
A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER,
W69-09954 06E

STATE AID IN FLOOD CONTROL MUNICIPAL-FEDERAL FLOOD CONTROL
PROJECTS.
W69-10048 06E

W69-10250 04A

FEEDING RATES
QUANTITATIVE RELATIONS OF THE FEEDING AND GROWTH OF DAPHNIA
PULEX OBUSA (KURZ) SCOURFIELD,
W69-10152 05C

FENCES
NAVIGABLE WATERCOURSES AS FENCES.
W69-10077 06E

STREAM CAVING AND ROAD CONSTRUCTION.
W69-10299 04C

FERRIES
MUNICIPAL BRIDGES, FERRIES, AND TERMINALS.
W69-10050 06E

STATE HIGHWAYS.
W69-10051 06E

RAILROAD COMPANY MAY OPERATE FERRY.
W69-10249 06E

FERTILIZATION
EXCESSIVE WATER FERTILIZATION,
W69-10178 05C

FERTILIZERS
WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS
RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH
CAROLINA.
W69-10294 03F

FIRE WASTES
PURIFICATION OF INDUSTRIAL WASTES (IN GERMAN),
W69-10264 05D

EFFLUENT TREATMENT AT A YORKSHIRE MILL.
W69-10274 05D

FIELD STUDIES
FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO
MOUNTAIN LAKES,
W69-10154 02H

FILTERS
STRAINER/FILTER TREATMENT OF COMBINED SEWER OVERFLOWS,
W69-10254 05D

FILTRATION
ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION,
W69-09927 06E

FINANCIAL ANALYSES
ECONOMIC ASPECTS OF PRIVATELY OWNED FISHING ENTERPRISES IN
WISCONSIN,
W69-10191 06D

FINANCING
SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL
BORROWING,
W69-09976 06A

FINISHING WASTES

KNIT GOODS FINISHERS AND BIODEGRADABLE DETERGENTS,
W69-10267 05D

WATER AND WASTES SYSTEM FOR AN 'INSTANT FACTORY'.
W69-10279 05D

DISPOSAL OF COMBINED TEXTILE FINISHING WASTES AND DOMESTIC
SEWAGE,
W69-10288 05D

BLEACHERY WASTES TREATED BY NUTRIENTS AND HIGH-RATE FILTER
PLANT.
W69-10289 05D

FIRE EFFECTS
HYDROLOGY OF FOREST LANDS AND RANGELANDS,
W69-10002 02A

FISH
STATE CONSERVATION COMMISSION.
W69-10053 06E

FISH.
W69-10227 06E

FISH CONSERVATION
FISH AND WILDLIFE REGULATIONS.
W69-10229 06E

FLOATING SORBENTS
CHEMICAL TREATMENT OF OIL SLICKS, A STATUS REPORT ON THE USE
OF CHEMICALS AND OTHER MATERIALS TO TREAT OIL SPILLED ON
WATER.
W69-10252 05D

FLOOD CONTROL
STATE AID IN FLOOD CONTROL MUNICIPAL-FEDERAL FLOOD CONTROL
PROJECTS.
W69-10048 06E

WATER SUPPLY, DRAINAGE AND FLOOD CONTROL.
W69-10057 06E

WATER DRAINAGE AND LEVEE DISTRICTS.
W69-10061 06E

W69-10062 06E

W69-10063 06E

W69-10064 06E

FLOOD CONTROL.
W69-10072 06E

CONNECTICUT RIVER FLOOD CONTROL COMPACT.
W69-10224 04A

DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.
W69-10243 04A

W69-10244 04A

W69-10245 04A

STATE AID IN FLOOD CONTROL MUNICIPAL-FEDERAL FLOOD CONTROL
PROJECTS.
W69-10250 04A

FLOOD CONTROL DISTRICTS
DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.
W69-10243 04A

W69-10244 04A

W69-10245 04A

FLOOD DAMAGE
FLOODPLAIN INFORMATION, FIVE MILE CREEK, METROPOLITAN
BIRMINGHAM, ALABAMA.
W69-09896 04A

FLOODPLAIN INFORMATION, SWEETWATER, JACKSON, CAMP, BEAVER
RUN, AND BROMOLOW CREEKS, METROPOLITAN ATLANTA, GEORGIA.
W69-09897 04A

FLOODPLAIN INFORMATION, FOURCHE CREEK AND TRIBUTARIES,
LITTLE ROCK, ARKANSAS - PART 1.
W69-09898 04A

FLOOD PLAIN INFORMATION, MISSISSIPPI RIVER AT NATCHEZ,
MISSISSIPPI.
W69-10086 04A

FLOOD ROUTING
FLOOD CONTROL.
W69-10072 06E

FLOODPLAINS
FLOODPLAIN INFORMATION, FIVE MILE CREEK, METROPOLITAN
BIRMINGHAM, ALABAMA.
W69-09896 04A

FLOODS
BASIC DATA REPORT NO 3 FOR RESEARCH ON FLOOD FREQUENCY FOR
SMALL DRAINAGE AREAS,
W69-09895 02E

FLOODPLAIN INFORMATION, FIVE MILE CREEK, METROPOLITAN
BIRMINGHAM, ALABAMA.
W69-09896 04A

FLOODPLAIN INFORMATION, SWEETWATER, JACKSON, CAMP, BEAVER RUN, AND BROMOLOW CREEKS, METROPOLITAN ATLANTA, GEORGIA. W69-09897	04A	FRESHWATER THE FRESH WATER OF NEW YORK STATE ITS CONSERVATION AND USE. W69-09969	06B
FLOODPLAIN INFORMATION, FOURCHE CREEK AND TRIBUTARIES, LITTLE ROCK, ARKANSAS - PART 1. W69-09898	04A	FROST INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR, W69-10132	02A
FLOOD PLAIN INFORMATION, MISSISSIPPI RIVER AT NATCHEZ, MISSISSIPPI. W69-10086	04A	FROZEN GROUND INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR, W69-10132	02A
FLOODS OF JANUARY AND FEBRUARY 1969 IN CENTRAL AND SOUTHERN CALIFORNIA. W69-10089	02E	FUNCTIONAL MORPHOLOGY EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY. W69-10149	02H
SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958- SEPT 1967). W69-10093	02E	GAMMA RAYS MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH). W69-09904	07B
FLOODS OF JULY 2, 1968, IN JACKSON, MISSISSIPPI. W69-10101	02E	INSTRUMENTATION FOR SNOW GAGING -- YESTERDAY, TODAY, AND TOMORROW. W69-09992	07B
FLORIDA RULES OF THE INTERNAL IMPROVEMENT FUND OF THE STATE OF FLORIDA SOVEREIGNTY SUBMERGED AND TIDAL LANDS IN COASTAL AND INTRACOASTAL WATERS. W69-10042	06E	GAMMA-TRANSMISSION PROFILING RADIOSOPOTE SNOW DENSITY AND DEPTH GAGE. W69-09994	07B
BROWN V ELLINGSON (WITHDRAWAL OF LAKE WATER). W69-10059	06E	GAMMA-RAY SOIL MOISTURE METERS MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH). W69-09904	07B
FLOW GROUNDWATER LEGISLATION. W69-09981	06E	GAMMA-TRANSMISSION SYSTEM GAMMA-TRANSMISSION PROFILING RADIOSOPOTE SNOW DENSITY AND DEPTH GAGE. W69-09994	07B
FLOW AUGMENTATION ECONOMIC EVALUATION OF FLOW AUGMENTATION A SYSTEMS ANALYSIS CASE STUDY. W69-10190	05G	GASES OBSERVATIONS OF GASES IN CHESAPEAKE BAY SEDIMENTS. W69-09900	02K
FLOW RATES INDUSTRIAL POLLUTION OF INTERNATIONAL BOUNDARY WATERS ALONG THE NIAGARA FRONTIER. W69-10291	05B	ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS. W69-10124	02K
FLUCTUATION CHANGES IN THE OXYGEN DEFICIT OF LAKE WASHINGTON. W69-10182	05C	GELLING AGENTS CHEMICAL TREATMENT OF OIL SLICKS, A STATUS REPORT ON THE USE OF CHEMICALS AND OTHER MATERIALS TO TREAT OIL SPILLED ON WATER. W69-10252	05D
FLUID MECHANICS TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA 2, FINITE RESERVOIRS. W69-09926	08E	GEOCHEMISTRY MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING BRINES, THE SABKA, TRUCIAL COAST, ARABIAN GULF. W69-09906	02L
VISCOS DISSIPATION IN EXTERNAL NATURAL CONVECTION FLOWS. W69-10091	01A	EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS--2. W69-10092	01B
FLUORINE FLUORINE IN THE REGIONALLY METAMORPHOSED SKARNs OF THE CZECH MASSIF (CZECHOSLOVAKIAN). W69-10123	02K	GEOCHEMICAL EVOLUTION OF OUED SAOURA (NORTHWESTERN SAHARA) WATERS (FRENCH). W69-10114	02K
FORECASTING INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR. W69-10132	02A	GEOGRAPHICAL CONTIGUITY PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION. W69-09958	06C
FOREST MANAGEMENT REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE-LEHIGH EXPERIMENTAL FOREST. W69-10005	02A	GEOLoGIC CONTROL GEOLoGIC CONTROL OF RAINFALL-RUNOFF RELATIONS IN THE PEAK CREEK WATERSHED, PULASKI AND WYTHE COUNTIES, VIRGINIA. W69-10090	02A
FOREST HYDROLOGY RESEARCH IN THE UNITED STATES. W69-10006	09C	GEOLoGIC CONTROL OF RUNOFF GEOLoGIC CONTROL OF RAINFALL-RUNOFF RELATIONS IN THE PEAK CREEK WATERSHED, PULASKI AND WYTHE COUNTIES, VIRGINIA. W69-10090	02A
FOREST SUCCESSION RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA. W69-10172	02K	GEOLoGIC FORMATIONS DEPOSITIONAL ENVIRONMENTS OF SUBSURFACE POTOMAC GROUP IN MARYLAND. W69-10113	02J
CHANGE IN DISTRIBUTION AND AVAILABILITY OF NITROGEN WITH FOREST SUCCESSION ON NORTH SLOPES IN INTERIOR ALASKA. W69-10173	02K	GEOLoGIC INVESTIGATIONS GEOLoGy OF PROPOSED POWERSITES AT DEER LAKE AND KASNYKU LAKE, BARANOF ISLAND, SOUTHEASTERN ALASKA. W69-09911	08E
FORESTS CHANGE IN DISTRIBUTION AND AVAILABILITY OF NITROGEN WITH FOREST SUCCESSION ON NORTH SLOPES IN INTERIOR ALASKA. W69-10173	02K	GEOLoGy GEOLoGy OF PROPOSED POWERSITES AT DEER LAKE AND KASNYKU LAKE, BARANOF ISLAND, SOUTHEASTERN ALASKA. W69-09911	08E
FRANCE COMPARISONS IN RESOURCE MANAGEMENT. W69-09952	06B	GEOMETRIC PROGRAMMING GEOMETRIC PROGRAMMING NEW OPTIMIZATION TECHNIQUE FOR WATER RESOURCE ANALYSTS. W69-10020	06A
FREEZING MOISTURE MOVEMENT TO A FREEZING FRONT. W69-09928	02G	GEOPHYSICS GRAVIMETRIC ESTIMATION OF DEPTH TO AQUIFERS IN THE HAZEVA	
INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR. W69-10132	02A		
FRESH WATER SELF-ABSORPTION OF C-14 RADIATION IN FRESHWATER OSTRACODS. W69-10166	02H		
THE IMPORTANCE OF EXTRACELLULAR PRODUCTS OF ALGAE IN FRESHWATER. W69-10180	05C		

AREA, ARAVA VALLEY, ISRAEL, W69-09917	02F	GROUNDWATER LEGISLATION, W69-09981	06E
GEOGRAPHIA FLOODPLAIN INFORMATION, SWEETWATER, JACKSON, CAMP, BEAVER RUN, AND BROMOLOW CREEKS, METROPOLITAN ATLANTA, GEORGIA. W69-09897	04A	WATER RESOURCES OF THE JOPLIN AREA, MISSOURI, W69-10095	02F
GEYSERS INITIAL PERIODICITY OF NEW GEYSER, YELLOWSTONE NATIONAL PARK, W69-10078	02F	GROUND WATER SHARE OF THE WATER BALANCE AND AN EXAMPLE OF A RIVER CATCHMENT IN THE SEASIDE REGION (POLISH), W69-10104	02A
GLACIAL DRIFT GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECESSION IN THE NARVIKSKJOMEN DISTRICT, NORWAY, W69-09924	02C	EFFECT OF TECTONIC STRUCTURE ON THE OCCURRENCE OF GROUND WATER IN THE BASALT OF THE COLUMBIA RIVER GROUP OF THE DALLES AREA, OREGON AND WASHINGTON, W69-10107	02F
HYDROGEOLOGY OF THE SCIOTO RIVER VALLEY NEAR PIKETON, SOUTH- CENTRAL OHIO, W69-10105	02F	ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM, W69-10119	02K
GLACIERS GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECESSION IN THE NARVIKSKJOMEN DISTRICT, NORWAY, W69-09924	02C	ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS, W69-10120	02K
GOVERNMENT SOME NOTES ON THE LINDAHL THEORY OF DETERMINATION OF PUBLIC EXPENDITURES, W69-09951	06B	FLUORINE IN THE REGIONALLY METAMORPHOSED SKARNS OF THE CZECH MASSIF (CZECHOSLOVAKIAN), W69-10123	02K
PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION, W69-09958	06C	ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K
A PUBLIC CHOICE APPROACH TO PUBLIC UTILITY PRICING, W69-09962	06C	WATER RECORDS OF PUERTO RICO, 1958-63, W69-10134	02E
SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL BORROWING, W69-09976	06A	WATER-BEARING CHARACTERISTICS AND OCCURRENCE OF AQUIFERS IN MARTIN COUNTY, NORTH CAROLINA, W69-10144	02F
NEW HORIZONS IN WATER RESOURCES ADMINISTRATION, W69-09977	06B	HYDROGEOLOGY OF THE UPPER CAPIBARIBE BASIN PERNAMBUCO, BRAZIL A RECONNAISSANCE IN AN AREA OF CRYSTALLINE ROCKS, W69-10145	02F
GOVERNMENT SUPPORTS A NORMATIVE THEORY OF TRANSFERS, W69-09960	06B	GROUND WATER CONSERVATION. W69-10298	04B
COLLECTIVE-CONSUMPTION SERVICES OF INDIVIDUAL-CONSUMPTION GOODS, W69-09974	06C	GROUNDWATER BASINS USE OF A MATHEMATICAL MODEL IN THE HYDROLOGIC STUDY AS APPLIED TO THE VEGA DE GRENADE OF SPAIN (FRENCH), W69-10147	02F
GRASSLANDS TECHNIQUES IN GRASSLAND WATERSHED RESEARCH, W69-10007	02A	GROUNDWATER MINING GROUNDWATER IN OGALLALA FORMATION IN THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO, W69-09913	02F
GRAVELS REMOVAL OF SAND AND GRAVEL FROM NAVIGABLE WATERS AND SALE OR LEASE OF MINERALS ON STATE LANDS. W69-10074	06E	GROUNDWATER MOVEMENT TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA 2, FINITE RESERVOIRS, W69-09926	08E
GRAVIMETRY GRAVIMETRIC ESTIMATION OF DEPTH TO AQUIFERS IN THE HAZEVA AREA, ARAVA VALLEY, ISRAEL, W69-09917	02F	USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW PROBLEMS IN AQUIFER SYSTEMS, W69-09937	07C
GREAT BRITAIN COMPARISONS IN RESOURCE MANAGEMENT, W69-09952	06B	GROUND RATES QUANTITATIVE RELATIONS OF THE FEEDING AND GROWTH OF DAPHNIA PULEX OBOTUSA (KURZ) SCOURFIELD, W69-10152	05C
GREAT FALLS A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-09954	06E	EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO, W69-10158	05C
GREAT LAKES THE FRESH-WATER OF NEW YORK STATE ITS CONSERVATION AND USE. W69-09969	06B	HABITATS THE HABITAT OF LEUCOTHRIX MUCOR, A WIDESPREAD MARINE MICROORGANISM, W69-10161	05C
GREAT LAKES RIVER BASINS COMMISSION. W69-10247	06B	HALIDES MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING BRINES, THE SABKHA, TRUCIAL COAST, ARABIAN GULF, W69-09906	02L
GREAT LAKES REGION GREAT LAKES RIVER BASINS COMMISSION. W69-10247	06B	HARDNESS(WATER) VERSATILE ION EXCHANGE RESINS CAN SOLVE POLLUTION PROBLEMS. W69-10263	05D
GROUNDWATER GROUNDWATER IN OGALLALA FORMATION IN THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO, W69-09913	02F	HAZARD-ZONE OCCUPANCE THE FLOODPLAIN AND THE SEASHORE A COMPARATIVE ANALYSIS OF HAZARD-ZONE OCCUPANCE, W69-10204	06F
GRAVIMETRIC ESTIMATION OF DEPTH TO AQUIFERS IN THE HAZEVA AREA, ARAVA VALLEY, ISRAEL, W69-09917	02F	HELE-SHAW MODEL AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-10187	03F
COMPARISON BETWEEN ANALOG AND DIGITAL SIMULATION TECHNIQUES FOR AQUIFER EVALUATION, W69-09931	07C	HIGH ASWAN DAM ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION, W69-09972	06A
GROUND-WATER RESOURCES OF ESSEX COUNTY, NEW JERSEY, W69-09933	02F	HIGHWAYS STATE HIGHWAYS. W69-10051	06E
THE AVAILABILITY OF GROUNDWATER FROM THE POTOMAC FORMATION IN THE CHESAPEAKE AND DELAWARE CANAL AREA, DELAWARE, W69-09942	02F	EMINENT DOMAIN. W69-10185	04A
GROUNDWATER RESOURCES OF PAMPANGA PROVINCE, W69-09948	02F		

BOT SPRINGS	STREAMFLOW RECORDS FROM THE SAN DIMAS EXPERIMENTAL FOREST, 1939-1959,	02E
TEMPERATURE OPTIMA FOR ALGAL DEVELOPMENT IN YELLOWSTONE AND ICELAND HOT SPRINGS,	W69-09990	
W69-10160	05C	
HUMAN LIFE AND HEALTH		
CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS,	W69-09979	
W69-10160	06E	
HUNGARY		
FLOW MEASURING STRUCTURES IN THE HYDROLOGICAL OBSERVATION NETWORK,	W69-09929	
W69-10160	02E	
SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958,	W69-09939	
W69-10160	08A	
HYDRAULIC GRADIENT		
MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH),	W69-09904	
W69-10160	07B	
HYDRAULIC MACHINERY		
SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958,	W69-09939	
W69-10160	08A	
HYDRAULIC PROPERTIES		
MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH),	W69-09904	
W69-10160	07B	
HYDRAULIC STRUCTURES		
SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958,	W69-09939	
W69-10160	08A	
HYDRAULICS		
METHOD OF DETERMINING THE DISCHARGE OF TWO-LEVEL SPILLWAYS,	W69-10129	
W69-10160	08B	
HYDROELECTRIC PLANTS		
WATER POWER COMPANIES.	W69-10069	
W69-10160	06E	
HYDROELECTRIC POWER		
GEOLGY OF PROPOSED POWERSITES AT DEER LAKE AND KASNYKU LAKE, BARANOF ISLAND, SOUTHEASTERN ALASKA,	W69-09911	
W69-10160	08E	
HYDROGEN		
ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUD WATERS AND PETROLEUM,	W69-10119	
W69-10160	02K	
HYDROGEN ION CONCENTRATION		
A TABLE FOR CONVERTING PH TO HYDROGEN ION CONCENTRATION (HG) OVER THE RANGE 5-9,	W69-10148	
W69-10160	02K	
HYDROGEOLOGY		
HYDROGEOLOGY OF THE SCIOTO RIVER VALLEY NEAR PIKEON, SOUTHCENTRAL OHIO,	W69-10105	
W69-10160	02F	
HYDROLOGY OF A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,	W69-10110	
W69-10160	02E	
HYDROGRAPH ANALYSIS		
HYDROLOGY OF FOREST LANDS AND RANGELANDS,	W69-10002	
W69-10160	02A	
INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS,	W69-10098	
W69-10160	02A	
HYDROGRAPHS		
TOTAL RUNOFF TRAVEL TIME DURING THE FORMATION OF MIXED 'SURFACE-SUBSURFACE' RAIN FLOODS IN SMALL WATER COURSES,	W69-09915	
W69-10160	02A	
STREAMFLOW RECORDS FROM THE SAN DIMAS EXPERIMENTAL FOREST, 1939-1959,	W69-09990	
W69-10160	02E	
HYDROLOGIC ASPECTS		
HYDROLOGY OF FOREST LANDS AND RANGELANDS,	W69-10002	
W69-10160	02A	
FOREST HYDROLOGY RESEARCH IN THE UNITED STATES,	W69-10006	
W69-10160	09C	
HYDROLOGIC CYCLE		
REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE-LEHIGH EXPERIMENTAL FOREST,	W69-10005	
W69-10160	02A	
THE PROBLEM OF THORNTONWHITE AND MATHER'S METHOD OF WATER BALANCE IN ITS APPLICATION TO POLAND (POLISH),	W69-10127	
W69-10160	02A	
HYDROLOGIC DATA		
PROCESSING OF DIGITAL DATA LOGGER STD TAPES AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AND THE BUREAU OF COMMERCIAL FISHERIES, LA JOLLA, CALIFORNIA,	W69-09894	
W69-10160	07C	
BASIC DATA REPORT NO 3 FOR RESEARCH ON FLOOD FREQUENCY FOR SMALL DRAINAGE AREAS,	W69-09895	
W69-10160	02E	
STREAMFLOW RECORDS FROM THE SAN DIMAS EXPERIMENTAL FOREST, 1939-1959,	W69-09990	
W69-10160	02E	
FLOODS OF JANUARY AND FEBRUARY 1969 IN CENTRAL AND SOUTHERN CALIFORNIA,	W69-10089	
W69-10160	02E	
IDENTIFICATION OF SPECTRAL CHARACTERISTICS OF HYDROLOGICAL SERIES BY A MODIFICATION OF THE GRENADE-ROSSENBLATT METHOD (RUSSIAN),	W69-10096	
W69-10160	02E	
SURFACE-WATER DISCHARGE AND GROUND-WATER LEVELS IN THE EAST FORK RIVER AREA, SUBLLETTE COUNTY, WYOMING,	W69-10097	
W69-10160	02E	
SUMMARY OF HYDROLOGIC AND PHYSICAL PROPERTIES OF ROCK AND SOIL MATERIALS, AS ANALYZED BY THE HYDROLOGIC LABORATORY OF THE U.S. GEOLOGICAL SURVEY, 1948-60,	W69-10143	
W69-10160	02J	
HYDROLOGY		
SOIL WETTABILITY A NEGLECTED FACTOR IN WATERSHED MANAGEMENT,	W69-09991	
W69-10160	02G	
HYDROMETEOROLOGY		
EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT,	W69-09986	
W69-10160	07B	
MEASURING MOISTURE NEAR SOIL SURFACE. . .MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE,	W69-09987	
W69-10160	07B	
HYDROPOWER		
ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION,	W69-09972	
W69-10160	06A	
ICELAND HOT SPRINGS		
TEMPERATURE OPTIMA FOR ALGAL DEVELOPMENT IN YELLOWSTONE AND ICELAND HOT SPRINGS,	W69-10160	
W69-10160	05C	
IDAHO		
GROUND-WATER LEVELS IN IDAHO, 1969,	W69-10081	
W69-10160	02F	
IDAHO OBSERVATION WELL NETWORK		
GROUND-WATER LEVELS IN IDAHO, 1969,	W69-10081	
W69-10160	02F	
ILLINOIS		
NATURE OF TURBIDITY IN THE ILLINOIS RIVER,	W69-09885	
W69-10160	02J	
GEOLOGY FOR PLANNING IN MCHENRY COUNTY,	W69-09912	
W69-10160	06B	
CANALS AND WATERWAYS, RIVERS, LAKES, STREAMS.	W69-10043	
W69-10160	06E	
ILLINOIS WATERWAY.	W69-10044	
W69-10160	06E	
ILLINOIS AND MISSISSIPPI CANAL-STATE PARK.	W69-10045	
W69-10160	06E	
POWER TO ACQUIRE PIERS AND BEACHES.	W69-10046	
W69-10160	06E	
LEVEE IMPROVEMENT COMMISSION.	W69-10047	
W69-10160	06E	
STATE AID IN FLOOD CONTROL MUNICIPAL-FEDERAL FLOOD CONTROL PROJECTS.	W69-10048	
W69-10160	06E	
WATER SERVICE DISTRICT.	W69-10049	
W69-10160	06E	
MUNICIPAL BRIDGES, FERRIES, AND TERMINALS.	W69-10050	
W69-10160	06E	
STATE HIGHWAYS.	W69-10051	
W69-10160	06E	
WATER SUPPLY, DRAINAGE AND FLOOD CONTROL.	W69-10057	
W69-10160	06E	
PARK DISTRICTS ABUTTING PUBLIC WATERS.	W69-10183	
W69-10160	06E	
ACQUISITION OF SUBMERGED LANDS FOR PUBLIC PARK PURPOSES.	W69-10186	
W69-10160	06E	
FISH.	W69-10227	
W69-10160	06E	
POWER TO ACQUIRE PIERS AND BEACHES.	W69-10248	
W69-10160	06A	
STATE AID IN FLOOD CONTROL MUNICIPAL-FEDERAL FLOOD CONTROL PROJECTS.	W69-10250	
W69-10160	04A	
LOCATING SOURCE OF WATER SUPPLY OUTSIDE OF MUNICIPALITIES.	W69-10251	
W69-10160	04A	
ILLINOIS RIVER		

NATURE OF TURBIDITY IN THE ILLINOIS RIVER, W69-09885	02J	ECONOMICS AND THE ADMINISTRATION OF NATIONAL PLANNING, W69-09978	06B
IMPROVEMENTS LEVEE IMPROVEMENT COMMISSION. W69-10047	06E	INTERREGIONAL INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10013	06B
INDIAN OCEAN THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS, W69-10121	02K	DYNAMIC INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10014	06A
INDIANA CROSSING OF STREAMS BY RAILROADS. W69-10175	06E	THE INTERREGIONAL DYNAMIC INPUT-OUTPUT PROGRAMMING MODEL, W69-10015	06B
DRAINS, CULVERTS, AND BRIDGES AS PART OF THE STATE HIGHWAY. W69-10179	04A	ECONOMIC EVALUATION OF WATER PART VI A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY, W69-10016	06A
EMINENT DOMAIN. W69-10185	04A	ECONOMIC EVALUATION OF WATER PART 6, A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY, W69-10087	06B
LAKE MICHIGAN RIGHTS OF RIPARIAN OWNERS. W69-10218	06E	INSPECTION LEGAL ASPECTS OF CROSS CONNECTION INSPECTIONS, W69-10060	06E
SWAMP, SALINE, AND MEANDER LANDS OF STATE-PURCHASE FOR PUBLIC PARK OR FOREST PURPOSES. W69-10219	06E	INSTRUMENTATION SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958, W69-09939	08A
OPERATION OF WATERCRAFT. W69-10230	06E	HEATED THERMOPILE ANEMOMETER COMPARED WITH SENSITIVE CUP ANEMOMETER IN NATURAL AIRFLOW, W69-09985	07B
WATER SUPPLY. W69-10246	05G	WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER, W69-10136	02D
GREAT LAKES RIVER BASINS COMMISSION. W69-10247	06B	INVESTIGATION OF A METHOD OF MEASURING SNOW STORAGE BY USING THE GAMMA RADIATION OF THE EARTH, W69-10142	02C
GROUND WATER CONSERVATION. W69-10298	04B	INTERAGENCY COOPERATION LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK METROPOLITAN REGION, W69-10023	06A
STREAM CAVING AND ROAD CONSTRUCTION. W69-10299	04C	THE INTERSTATE COMPACT--A FORM OF CREATIVE FEDERALISM, W69-10214	06B
INDIVIDUAL PROVISION PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION. W69-09958	06C	INTERCEPTION TRANSPORT OF INTERCEPTED SNOW FROM TREES DURING SNOW STORMS, W69-09998	02C
INDONESIA SEMPOR PROJECT-GENERAL PLAN, W69-10100	08A	INTERNATIONAL WATERS THE COLUMBIA RIVER TREATY AND PROTOCOL AGREEMENT, W69-10209	06E
INDUS PLAINS EVALUATION AND CONTROL OF CORROSION AND ENCRUSTATION IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN, W69-09910	08G	INTERRELATED PROJECTS CAPITAL BUDGETING OF INTERRELATED PROJECTS SURVEY AND SYNTHESIS, W69-09971	06A
INDUSTRIAL WASTES MONTE CARLO SIMULATION OF WASTE DISCHARGE, W69-09880	05B	INTERSTATE COMMISSIONS THE INTERSTATE COMPACT--A FORM OF CREATIVE FEDERALISM, W69-10214	06B
AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH), W69-10088	05D	TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT. W69-10296	05G
PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE, W69-10139	05C	INTERSTATE COMPACTS A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-09954	06E
WATER AND WASTES SYSTEM FOR AN 'INSTANT FACTORY'. W69-10279	05D	TENNESSEE TOMBIGBEE WATERWAY DEVELOPMENT COMPACT. W69-10010	06E
INDUSTRIAL POLLUTION OF INTERNATIONAL BOUNDARY WATERS ALONG THE NIAGARA FRONTIER, W69-10291	05B	INTERSTATE WATERSHED COOPERATION ACT. W69-10070	06E
INDUSTRIAL WATER AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH), W69-10088	05D	THE INTERSTATE COMPACT--A FORM OF CREATIVE FEDERALISM, W69-10214	06B
INFILTRATION SOIL WETTABILITY A NEGLECTED FACTOR IN WATERSHED MANAGEMENT, W69-09991	02G	CONNECTICUT RIVER FLOOD CONTROL COMPACT. W69-10224	04A
IMPROVED SEALANTS FOR INFILTRATION CONTROL, THE DEVELOPMENT AND DEMONSTRATION OF MATERIALS TO REDUCE OR ELIMINATE WATER INFILTRATION INTO SEWAGE. W69-10255	05G	TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT. W69-10296	05G
INFILTRATION CONTROL IMPROVED SEALANTS FOR INFILTRATION CONTROL, THE DEVELOPMENT AND DEMONSTRATION OF MATERIALS TO REDUCE OR ELIMINATE WATER INFILTRATION INTO SEWAGE. W69-10255	05G	INTERSTATE WATER SANITATION BOARD. W69-10297	05G
INFRARED RADIATION INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS, W69-09932	07B	INTERTIDAL AREAS RULES OF THE INTERNAL IMPROVEMENT FUND OF THE STATE OF FLORIDA SOVEREIGNTY SUBMERGED AND TIDAL LANDS IN COASTAL AND INTRACOASTAL WATERS. W69-10042	06E
INLAND WATERWAYS WATERCOURSES AND CUTS GENERALLY. W69-10041	06E	INVESTMENT PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS, W69-10011	06A
ILLINOIS WATERWAY. W69-10044	06E	ION EXCHANGE REMOVING DETERGENTS FROM WASTE WATERS NEW LOW-COST METHODS. W69-10275	05D
WINNIPEG BAY TO SOUTH, ASHLEY RIVER AND SHIPTON RIVER. W69-10238	04A	ION EXCHANGE RESINS VERSATILE ION EXCHANGE RESINS CAN SOLVE POLLUTION PROBLEMS. W69-10263	05D
INPUT-OUTPUT ANALYSIS			

IOWA			
EMINENT DOMAIN.			
W69-10052	06E		
STATE CONSERVATION COMMISSION.			
W69-10053	06E		
PUBLIC USE OF PRIVATE LANDS AND WATERS.			
W69-10054	06E		
WATER RECREATIONAL AREAS.			
W69-10055	06E		
BRIDGES.			
W69-10056	06E		
WATER RIGHTS LAW IN IOWA.			
W69-10216	06C		
DOCKS.			
W69-10232	04A		
LEVEE AND DRAINAGE DISTRICTS.			
W69-10233	04A		
SKAFF V SIOUX CITY (UNREASONABLE DELAY IN CONDEMNATION PROCEEDINGS).			
W69-10241	04A		
IRON OXIDATION			
OXYGENATION OF IRON(II) IN CONTINUOUS REACTORS,			
W69-10293	05D		
IRRIGATION			
ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION.			
W69-09972	06A		
AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER.			
W69-10187	03F		
WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA.			
W69-10294	03F		
IRRIGATION DISTRICTS			
ARKANSAS IRRIGATION, DRAINAGE AND WATERSHED IMPROVEMENT DISTRICT ACT OF 1949.			
W69-10065	06E		
IRRIGATION EFFICIENCY			
DYNAMICS OF OBJECTS IRRIGATORY SYSTEMS REGULATION,			
W69-10025	03F		
IRRIGATION WITH RESTRAINTS ON LAND AND WATER RESOURCES.			
W69-10189	03F		
IRRIGATION ENGINEERING			
SEMPOR PROJECT-GENERAL PLAN,			
W69-10100	08A		
IRRIGATION PERMITS			
IRRIGATION WITH RESTRAINTS ON LAND AND WATER RESOURCES.			
W69-10189	03F		
IRRIGATION PRACTICES			
STUDY OF IRRIGATION BY SPRINKLING (FRENCH).			
W69-09903	03F		
ISLAND FORMATION			
SALE OF ISLANDS.			
W69-10073	06E		
ISLANDS			
SEWAGE DISPOSAL SYSTEMS ON ISLANDS.			
W69-10034	06E		
SALE OF ISLANDS.			
W69-10073	06E		
ISRAEL			
GRAVIMETRIC ESTIMATION OF DEPTH TO AQUIFERS IN THE HAZEVA AREA, ABAVA VALLEY, ISRAEL,			
W69-09917	02F		
JACKSON(MISS)			
FLOODS OF JULY 2, 1968, IN JACKSON, MISSISSIPPI,			
W69-10101	02E		
JOINT TREATMENT PLANT			
JOINT MUNICIPAL AND SEMICHEMICAL PULPING WASTE TREATMENT, A PILOT STUDY EVALUATING COMBINED TREATMENT OF DOMESTIC SEWAGE AND WEAK SEMICHEMICAL PULPING AND PAPERMAKING WASTES.			
W69-10253	05D		
JUDICIAL DECISIONS			
ARIZONA V. CALIFORNIA -- A BRIEF REVIEW,			
W69-10212	06E		
JURISDICTION			
DRAINAGE OF LOW LANDS.			
W69-10225	04A		
KANSAS			
IRRIGATION WITH RESTRAINTS ON LAND AND WATER RESOURCES.			
W69-10189	03F		
KENTUCKY			
		POWER TO ACQUIRE AND DISPOSE OF PROPERTY RESTRICTIONS AS TO DISPOSITION OF WATER FRONT.	
		W69-09889	06E
		LANDS IN OHIO RIVER BED.	
		W69-09890	06E
		WATERWAYS AND MILLDAMS.	
		W69-10008	06E
		TENNESSEE TOMBIGBEE WATERWAY DEVELOPMENT COMPACT.	
		W69-10010	06E
		DEPARTMENT OF NATURAL RESOURCES.	
		W69-10228	06E
		FISH AND WILDLIFE REGULATIONS.	
		W69-10229	06E
		DISTRICTS TO MAINTAIN AND OPERATE FLOOD CONTROL WORKS.	
		W69-10243	04A
		W69-10244	04A
		W69-10245	04A
		RAILROAD COMPANY MAY OPERATE FERRY.	
		W69-10249	06E
		TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT.	
		W69-10296	05G
		INTERSTATE WATER SANITATION BOARD.	
		W69-10297	05G
		KINETICS	
		KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS.	
		W69-10258	05D
		LAISSEZ-FAIRE ECONOMICS	
		CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS,	
		W69-09979	06E
		LAKE CHANGES	
		CHANGES IN WESTERN LAKE ERIE DURING THE PERIOD 1948-1962.	
		W69-10156	02H
		LAKE ERIE	
		CHANGES IN WESTERN LAKE ERIE DURING THE PERIOD 1948-1962.	
		W69-10156	02H
		LAKE MICHIGAN	
		LAKE MICHIGAN RIGHTS OF RIPARIAN OWNERS.	
		W69-10218	06E
		LAKE MINNETONKA(MINN)	
		ALGAE AND PHOSPHORUS IN LAKE MINNETONKA.	
		W69-10167	05C
		LAKE ONTARIO	
		EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO,	
		W69-10158	05C
		LAKE SOILS	
		SEDIMENTS FROM DANISH LAKES.	
		W69-10174	02H
		LAKE TYPOLGY	
		SEDIMENTS FROM DANISH LAKES.	
		W69-10174	02H
		TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD.	
		W69-10181	02H
		LAKE WASHINGTON(WASH)	
		ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON.	
		W69-10169	05C
		CHANGES IN THE OXYGEN DEFICIT OF LAKE WASHINGTON.	
		W69-10182	05C
		LAGES	
		CHEMISTRY OF N AND MN IN COX HOLLOW LAKE.	
		W69-09881	05A
		UNSTEADY CIRCULATION IN SHALLOW LAKES.	
		W69-09886	02H
		INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS.	
		W69-09932	07B
		RIVERS AND LAKES OF THE MONGOLIAN PEOPLE'S REPUBLIC (RUSSIAN).	
		W69-09941	02E
		BROWN V ELLINGSON (WITHDRAWAL OF LAKE WATER).	
		W69-10059	06E
		FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO MOUNTAIN LAKES.	
		W69-10154	02H
		ON CONTROL OF LAKE EUTROPHICATION EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS--(IN GERMAN).	
		W69-10164	05C

OBSERVATIONS ON EXCESSIVE WEED GROWTH IN TWO LAKES IN NEW ZEALAND, W69-10168	05C	LINEAR PROGRAMMING INTERREGIONAL INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10013 06B
ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON, W69-10169	05C	DYNAMIC INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10014 06A
EUTROPHICATION OF LAKES AND RIVERS ITS ORIGIN AND PREVENTION (IN GERMAN), W69-10170	05C	THE INTERREGIONAL DYNAMIC INPUT-OUTPUT PROGRAMMING MODEL, W69-10015 06B
SEDIMENTS FROM DANISH LAKES, W69-10174	02H	STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN, W69-10018 06A
TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD, W69-10181	02H	LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK METROPOLITAN REGION, W69-10023 06A
LAND DEVELOPMENT SWAMP, SALINE, AND MEANDER LANDS OF STATE-PURCHASE FOR PUBLIC PARK OR FOREST PURPOSES. W69-10219	06E	ECONOMIC EVALUATION OF FLOW AUGMENTATION & SYSTEMS ANALYSIS CASE STUDY, W69-10190 05G
LAND USE WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN, W69-09947	05G	LITHIFICATION ARAGONITE-CEMENTED SANDSTONE FROM OUTER CONTINENTAL SHELF OFF DELAWARE BAY SUBMARINE LITHIFICATION MECHANISM YIELDS PRODUCT RESEMBLING BEACHROCK, W69-09908 02L
POLITICS AND LAND USE THE INDIANA SHORELINE OF LAKE MICHIGAN, W69-10199	06E	LITTORAL RIGHTS BLOOM V WATER RESOURCES COMMISSION (RELATIVE RIGHTS OF OWNERS OF ADJACENT UPLANDS), W69-10240 04A
SWAMP, SALINE, AND MEANDER LANDS OF STATE-PURCHASE FOR PUBLIC PARK OR FOREST PURPOSES. W69-10219	06E	LOCAL GOVERNMENTS WATER SERVICE DISTRICT, W69-10049 06E
LANDFILLS WHARF LINES AND BULKHEADS. W69-10033	06E	ACQUISITION OF SUBMERGED LANDS FOR PUBLIC PARK PURPOSES, W69-10186 06E
LANDSLIDES MECHANICS AND RATES OF NATURAL SOIL CREEP, W69-09988	07B	LOCATING RESERVOIR LOCATION FOR URBAN RECREATION, W69-10022 04C
LANOLIN AERATION RECOVERY OF LANOLIN FROM WOOL SCOUR LIQUORS, W69-10286	05G	LOS ANGELES COUNTY WASTE WATER RECLAMATION, LOS ANGELES COUNTY, W69-10197 05D
LAS VEGAS(NEV) AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-10187	03F	LOUISIANA MEETING STATE RESPONSIBILITY IN WATER RESOURCES DEVELOPMENT, W69-10194 06B
LEASES POWER TO ACQUIRE AND DISPOSE OF PROPERTY RESTRICTIONS AS TO DISPOSITION OF WATER FRONT. W69-09889	06E	MACROANALYSIS CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS, W69-09980 06B
LANDS IN OHIO RIVER BED. W69-09890	06E	ACTIVITY ANALYSIS IN WATER PLANNING, W69-09982 06B
LEAST SQUARES METHOD ALTERNATIVE ASYMPTOTIC TESTS OF SIGNIFICANCE AND RELATED ASPECTS OF 2SLS AND 3SLS ESTIMATED PARAMETERS. W69-09953	06A	MACROMOLECULES THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHORYLATION, AND MACROMOLECULES IN BENTHIC ALGAL MATS, W69-10151 05C
LEGISLATION WATER RIGHTS LAW IN IOWA, W69-10216	06C	MAINE STANTON V TRUSTEES OF ST JOSEPH'S COLLEGE (RESPECTIVE RIGHTS OF UPSTREAM AND DOWNSTREAM RIPARIAN OWNERS WHEN UPSTREAM USE IS TO BE NON-RIPARIAN), W69-09968 05G
TRENDS IN WATER RIGHTS LEGISLATION. W69-10217	06B	RUBIN V W. H. HINMAN, INC. (STATE DRAINAGE EASEMENTS), W69-10226 04A
A REVIEW OF THE LITERATURE OF 1964 ON WASTE WATER AND WATER POLLUTION CONTROL. W69-10271	05D	MANAGEMENT CAPITAL BUDGETING OF INTERRELATED PROJECTS SURVEY AND SYNTHESIS, W69-09971 06A
A REVIEW OF THE LITERATURE OF 1963 ON WASTE WATER AND WATER POLLUTION CONTROL. W69-10272	05D	SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL BORROWING, W69-09976 06A
LEUCOTHRIX MUCOR THE HABITAT OF LEUCOTHRIX MUCOR, A WIDESPREAD MARINE MICROORGANISM, W69-10161	05C	MARINE MICROORGANISMS THE HABITAT OF LEUCOTHRIX MUCOR, A WIDESPREAD MARINE MICROORGANISM, W69-10161 05C
LEVEES LEVEE IMPROVEMENT COMMISSION. W69-10047	06E	MARKET ECONOMIES PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION, W69-09958 06C
LIGHT INTENSITY RECORDED OBSERVATIONS ON THE INFLUENCE OF CLOUDINESS AND WIND VELOCITY ON THE BRIGHTNESS OF THE DAYLIGHT SKY ABOVE THE WATER SPACE (RUSSIAN), W69-09899	02B	MARKET MECHANISM ECONOMICS AND THE ADMINISTRATION OF NATIONAL PLANNING, W69-09978 06B
LIMITING CONSTITUENTS ON CONTROL OF LAKE EUTROPHICATION EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS--(IN GERMAN), W69-10164	05C	MARKOV PROCESSES PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES, W69-09902 02A
LIMNOLOGY FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO MOUNTAIN LAKES, W69-10154	02H	MARTIN COUNTY(NC) WATER-BEARING CHARACTERISTICS AND OCCURRENCE OF AQUIFERS IN MARTIN COUNTY, NORTH CAROLINA, W69-10144 02F
SOME FEATURES OF SALINE LAKES IN CENTRAL WASHINGTON, W69-10165	02H	MARINE FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY,

W69-09901	02L	MICROSTRAINING THE RANGE OF CHOICE IN WATER MANAGEMENT, W69-09964	05G
PUBLIC WATERSHED ASSOCIATIONS.	04D	MICROWAVES MICROWAVE RADIOMETRIC SENSING OF SOIL MOISTURE CONTENT, W69-09916	07B
W69-10028	04D	DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE, W69-10140	07B
W69-10029	04D		
W69-10030	04D		
W69-10031	04D		
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN MARYLAND.	04A		
W69-10103	04A		
MASS TRANSPORT MOISTURE MOVEMENT TO A FREEZING FRONT, W69-09928	02G		
MATHEMATICAL MODELS INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT, W69-09891	05B		
USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW PROBLEMS IN AQUIFER SYSTEMS, W69-09937	07C		
PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS, W69-10011	06A		
IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS, W69-10019	02F		
GEOMETRIC PROGRAMMING NEW OPTIMIZATION TECHNIQUE FOR WATER RESOURCE ANALYSTS, W69-10020	06A		
DYNAMICS OF OBJECTS IRRIGATORY SYSTEMS REGULATION, W69-10025	03F		
ECONOMIC EVALUATION OF WATER PART 6, A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY, W69-10087	06B		
IDENTIFICATION OF SPECTRAL CHARACTERISTICS OF HYDROLOGICAL SERIES BY A MODIFICATION OF THE GRENDANDER-ROSSENBLATT METHOD (BUSSIAN), W69-10096	02E		
USE OF A MATHEMATICAL MODEL IN THE HYDROLOGIC STUDY AS APPLIED TO THE VEGA DE GRENADE DE SPAIN (FRENCH), W69-10147	02F		
MATHEMATICAL STUDIES SIMULATION OF ECONOMIC SYSTEMS, W69-09949	06A		
DETERMINATION OF DYNAMIC PRESSURE OF WATER ON A DAM USING THE EHD METHOD AND TAKING INTO CONSIDERATION THE DAM ELASTICITY (RUSSIAN), W69-10099	08B		
DEVELOPED EQUATION OF THE WATER BALANCE (POLISH), W69-10108	02A		
THE PROBLEM OF THORNTHWAITE AND MATHER'S METHOD OF WATER BALANCE IN ITS APPLICATION TO POLAND (POLISH), W69-10127	02A		
IRRIGATION WITH RESTRAINTS ON LAND AND WATER RESOURCES, W69-10189	03F		
MEASUREMENT THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHYLATION, AND MACROMOLECULES IN BENTHIC ALGAL MATS, W69-10151	05C		
MEASURING INSTRUMENTS MODIFICATIONS AND EVALUATING OF THE EVAPOTRANSPIRATION TENT, W69-09984	02D		
METAMORPHIC ROCKS FLUORINE IN THE REGIONALLY METAMORPHOSED SKARNS OF THE CZECH MASSIF (CZECHOSLOVAKIAN), W69-10123	02K		
METEOROLOGY EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT, W69-09986	07B		
MEASURING MOISTURE NEAR SOIL SURFACE. . . MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE, W69-09987	07B		
ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS, W69-10130	02G		
METROPOLITAN COMPREHENSIVE PLANNING TRENDS IN METROPOLITAN WATER DEVELOPMENT, W69-10195	06B		
MICROBIOLOGY DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER, W69-10125	02K		
MICROSCOPIC EXAMINATION ALGAE CONTROL WITH COPPER SULFATE, W69-10157	05G		
MICROSTRAINING THE RANGE OF CHOICE IN WATER MANAGEMENT, W69-09964			
MICROWAVES MICROWAVE RADIOMETRIC SENSING OF SOIL MOISTURE CONTENT, W69-09916			
DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE, W69-10140			
MICRO-AUTORADIOGRAPHY THE APPLICATION OF MICRO-AUTORADIOGRAPHIC TECHNIQUES TO ECOLOGICAL STUDIES, W69-10163			
MINERAL WATER EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS--2, W69-10092			
MINERALOGY EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS--2, W69-10092			
ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS, W69-10117			
MINERALS REMOVAL OF SAND AND GRAVEL FROM NAVIGABLE WATERS AND SALE OR LEASE OF MINERALS ON STATE LANDS, W69-10078			
MINNESOTA SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958- SEPT 1967), W69-10093			
MISSISSIPPI BASIC DATA REPORT NO 3 FOR RESEARCH ON FLOOD FREQUENCY FOR SMALL DRAINAGE AREAS, W69-09895			
FLOOD PLAIN INFORMATION, MISSISSIPPI RIVER AT NATCHEZ, MISSISSIPPI, W69-10086			
FLOODS OF JULY 2, 1968, IN JACKSON, MISSISSIPPI, W69-10101			
MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, MISSISSIPPI RIVER AT NATCHEZ, MISSISSIPPI, W69-10086			
MISSOURI WATER RESOURCES OF THE JOPLIN AREA, MISSOURI, W69-10095			
MIXING ARTIFICIAL DESTRATIFICATION IN RESERVOIRS OF THE CALIFORNIA STATE WATER PROJECT, W69-09883			
MODEL ACT STATE REGULATION OF CHANNEL ENCROACHMENTS, W69-10207			
MODEL STUDIES NUMERICAL SIMULATION OF WAVE-CREST MOVEMENT IN RIVERS AND ESTUARIES, W69-09919			
HYDROLOGIC DISTRIBUTIONS RESULTING FROM MIXED POPULATIONS AND THEIR COMPUTER SIMULATION, W69-09935			
SIMULATION OF INDIVIDUAL AND GROUP BEHAVIOR, W69-09950			
STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN, W69-10018			
AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-10187			
MOLECULAR STRUCTURE DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER, W69-10125			
MONITORING RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT, W69-10080			
MONO LAKE(CALIF) INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS, W69-09932			

MORPHOLOGY	NEW MEXICO
STUDIES ON MORPHOGENESIS IN A BLUE-GREEN ALGA. I. EFFECT OF INORGANIC NITROGEN SOURCES ON DEVELOPMENTAL MORPHOLOGY OF ANABANNA DOLIOLUM.	EVAPORATION INVESTIGATIONS AT ELEPHANT BUTTE RESERVOIR IN NEW MEXICO,
W69-10177	W69-09934
05C	02D
MOSKVA RIVER	NEW YORK
PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE,	THE FRESH WATER OF NEW YORK STATE ITS CONSERVATION AND USE.
W69-10139	W69-09969
05C	06B
MOUNTAINS	PADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT.
FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO MOUNTAIN LAKES.	W69-10080
W69-10154	05C
02H	05C
MULTIPLE-PURPOSE PROJECTS	NEW ZEALAND
STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN.	OBSERVATIONS ON EXCESSIVE WEED GROWTH IN TWO LAKES IN NEW ZEALAND,
W69-10018	W69-10168
06A	05C
MUNICIPAL WASTES	NILE RIVER
PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE,	ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION.
W69-10139	W69-09972
05C	06A
MUNICIPAL WATER	NITRATES
MUNICIPAL WATER FROM WESTERN RIVERS.	OCURRENCE OF SULFATE AND NITRATE IN RAINFALL.
W69-09970	W69-10153
06B	05B
NAS-NRC COMMITTEE ON NATURAL RESOURCES	NITROGEN
RESEARCH ON NATURAL RESOURCES A REVIEW AND COMMENTARY.	CHANGE IN DISTRIBUTION AND AVAILABILITY OF NITROGEN WITH FOREST SUCCESSION ON NORTH SLOPES IN INTERIOR ALASKA.
W69-10210	W69-10173
06D	02K
NATURAL FLOW DOCTRINE	NODAL REGIONS
DAVIS V CAHOON (DIVERSION OF NATURAL FLOW BY LOWER LANDOWNER PROHIBITED).	REGIONAL ECONOMICS A SURVEY.
W69-10239	W69-09975
04A	06B
NATURAL RESOURCES	NON-RIPARIAN USES
COMPARISONS IN RESOURCE MANAGEMENT.	STANTON V TRUSTEES OF ST JOSEPH'S COLLEGE (RESPECTIVE RIGHTS OF UPSTREAM AND DOWNSTREAM RIPARIAN OWNERS WHEN UPSTREAM USE IS TO BE NON-RIPARIAN).
W69-09952	W69-09968
06B	05G
DEPARTMENT OF NATURAL RESOURCES.	NORTH CAROLINA
W69-10228	WATER RESOURCES RESEARCH INTERESTS IN THE SENIOR COLLEGES AND UNIVERSITIES OF NORTH CAROLINA.
06E	W69-10083
NAVIGABLE RIVERS	INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA.
NAVIGABLE WATERCOURSES AS FENCES.	W69-10084
W69-10077	09A
NAVIGABLE WATERS	WATER-BEARING CHARACTERISTICS AND OCCURRENCE OF AQUIFERS IN MARTIN COUNTY, NORTH CAROLINA.
CANALS AND WATERWAYS, RIVERS, LAKES, STREAMS.	W69-10144
W69-10043	02F
06E	DAVIS V CAHOON (DIVERSION OF NATURAL FLOW BY LOWER LANDOWNER PROHIBITED).
PACKET AND NAVIGATION COMPANIES--COAL AND STONE COMPANIES.	W69-10239
W69-10075	04A
PARK DISTRICTS ABUTTING PUBLIC WATERS.	NORTHWAY
W69-10183	GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECESSION IN THE NARVIKSKJOMEN DISTRICT, NORWAY.
06E	W69-09924
ARKANSAS WATERWAYS COMMISSION.	02C
W69-10236	NUCLEAR METERS
WHITE RIVER NAVIGATION DISTRICT COMMISSION.	INVESTIGATION OF A METHOD OF MEASURING SNOW STORAGE BY USING THE GAMMA RADIATION OF THE EARTH.
W69-10235	W69-10142
04A	02C
WINYAH BAY TO SOUTH, ASHLEY RIVER AND SHIPYARD RIVER.	NUCLEAR MOISTURE METERS
W69-10238	MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH).
04A	W69-09904
NEBRASKA	07B
SEDIMENTATION IN BROWNELL CREEK SUBWATERSHED NO. 1, NEBRASKA.	EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT.
W69-09946	W69-09986
04D	07B
NEVADA	MEASURING MOISTURE NEAR SOIL SURFACE. . .MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE.
INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS.	W69-09987
W69-09932	07B
07B	NUCLEAR SNOW GAGE
NEW ENGLAND	INSTRUMENTATION FOR SNOW GAGING -- YESTERDAY, TODAY, AND TOMORROW.
A STUDY OF THE FEASIBILITY OF SOCIAL SCIENCE RESEARCH DESIGNED TO IDENTIFY AND ANALYZE SOCIAL RESPONSES TO PRECIPITATION MANAGEMENT OPERATIONS IN NEW ENGLAND.	W69-09992
W69-10192	07B
06B	GAMMA-TRANSMISSION PROFILING RADIOSOTIPE SNOW DENSITY AND DEPTH GAGE.
NEW HAMPSHIRE	W69-09994
SEWAGE DISPOSAL SYSTEMS ON ISLANDS.	07B
W69-10034	NUTRIENT AVAILABILITY
06E	RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA.
WATER POLLUTION AND DISPOSAL OF WASTES.	W69-10172
W69-10035	02K
05B	NUTRIENTS
W69-10036	RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA.
05B	W69-10172
W69-10037	02K
05B	OBSERVATION WELLS
W69-10038	GROUND-WATER LEVELS IN IDAHO, 1969.
05B	W69-10081
FUTURE SUPPLIES OF WATER FOR DOMESTIC USE.	02F
W69-10039	W69-10081
06E	OHIO
TESTING OF WATER SUPPLIES.	HYDROGEOLOGY OF THE SCIOTO RIVER VALLEY NEAR PIKETON, SOUTH-CENTRAL OHIO.
W69-10040	W69-10105
06E	02F
ERCTION AND INSPECTION OF DAMS.	OHIO RIVER
W69-10223	
04A	
NEW JERSEY	
GROUND-WATER RESOURCES OF ESSEX COUNTY, NEW JERSEY.	
W69-09933	
02F	

LANDS IN OHIO RIVER BED. W69-09890	06E	OPTIMUM DEVELOPMENT PLANS(MINIMUM COST) SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE, W69-10292	06A
OIL FIELDS ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS. W69-10124	02K	OPTION VALUE RESOURCE ALLOCATION WITH PROBABILISTIC INDIVIDUAL PREFERENCES, W69-09956	06C
OIL INDUSTRY WATER USE IN THE PETROLEUM AND NATURAL GAS INDUSTRIES, W69-09944	06D	OPTION-DEMAND COLLECTIVE-CONSUMPTION SERVICES OF INDIVIDUAL-CONSUMPTION GOODS, W69-09974	06C
OIL RESERVOIRS ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM, W69-10119	02K	OREGON EFFECT OF TECTONIC STRUCTURE ON THE OCCURRENCE OF GROUND WATER IN THE BASALT OF THE COLUMBIA RIVER GROUP OF THE DALLES AREA, OREGON AND WASHINGTON, W69-10107	02F
OIL SPILLS-CHEMICAL TREATMENT CHEMICAL TREATMENT OF OIL SLICKS, A STATUS REPORT ON THE USE OF CHEMICALS AND OTHER MATERIALS TO TREAT OIL SPILLED ON WATER. W69-10252	05D	ORGANIC COMPOUNDS DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER, W69-10125	02K
OIL WASTES THE DECOMPOSITION OF PETROLEUM PRODUCTS IN OUR NATURAL WATERS, W69-10082	05B	ORTHOPHOSPHATES REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA, W69-10176	05G
PURIFICATION OF INDUSTRIAL WASTES (IN GERMAN), W69-10264	05D	OSTRACODS SELF-ABSORPTION OF C-14 RADIATION IN FRESHWATER OSTRACODS, W69-10166	02H
OPEN CHANNEL FLOW DISPERSION OF FLOATING PARTICLES IN UNIFORM CHANNEL FLOW, W69-09887	02J	OUED SAOURA GEOCHEMICAL EVOLUTION OF OUED SAOURA (NORTHWESTERN SAHARA) WATERS (FRENCH), W69-10114	02K
LONGITUDINAL DISPERSION IN OPEN CHANNELS, W69-09898	02E	OUTDOOR RECREATION IMPACTS OF RECREATION ON COMPETITION FOR USE OF WATER, W69-10202	06D
FRICITION-FACTORS FOR FLAT-BED FLOWS IN SAND CHANNELS, W69-09893	02E	OVERDRAFT LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA, W69-10135	04B
OPERATIONS RESEARCH IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL, W69-09936	06A	OVERFLOW CONTROL POLYMERS FOR SEWER FLOW CONTROL, THE DEVELOPMENT AND DEMONSTRATION OF THE USE OF POLYMERS TO REDUCE OR ELIMINATE SEWER OVERFLOWS BY FLOW ENERGY REDUCTION, W69-10256	05C
SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL BORROWING, W69-09976	06A	OWNERSHIP OF BEDS SALE OF ISLANDS. W69-10073	06E
PLANNING APPROACHES TO WATER RESOURCES DEVELOPMENT AND UTILIZATION IN ISRAEL, W69-10026	06A	OXYGEN CHANGES IN THE OXYGEN DEFICIT OF LAKE WASHINGTON, W69-10182	05C
OPTIMAL OUTPUT A NORMATIVE THEORY OF TRANSFERS, W69-09960	06B	OXYGEN DEFICIT CHANGES IN THE OXYGEN DEFICIT OF LAKE WASHINGTON, W69-10182	05C
OPTIMIZATION MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER, W69-09918	06A	OXYGEN DEMAND STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES, W69-09879	05B
PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION, W69-09958	06C	OXYGENATION JOINT MUNICIPAL AND SEMICHEMICAL PULPING WASTE TREATMENT, A PILOT STUDY EVALUATING COMBINED TREATMENT OF DOMESTIC SEWAGE AND WEAK SEMICHEMICAL PULPING AND PAPERMAKING WASTES. W69-10253	05D
A NORMATIVE THEORY OF TRANSFERS, W69-09960	06B	PAKISTAN EVALUATION AND CONTROL OF CORROSION AND ENCROACHMENT IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN, W69-09910	08G
ON THE PURE THEORY OF PUBLIC GOODS, W69-09966	06C	PALAEHYDROLOGY EXPERIMENTAL PALEOHYDROLOGIC INVESTIGATIONS, W69-10141	02E
CONJUNCTIVE USE OF GROUND AND SURFACE WATERS, W69-10012	06A	PARETIAN CRITERION PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION, W69-09958	06C
ECONOMIC EVALUATION OF WATER PART VI A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY, W69-10016	06A	PARETO OPTIMALITY A PUBLIC CHOICE APPROACH TO PUBLIC UTILITY PRICING, W69-09962	06C
DISCRETE DYNAMIC PROGRAMMING AND CAPITAL ALLOCATION, W69-10017	06C	ON THE PURE THEORY OF PUBLIC GOODS, W69-09966	06C
STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN, W69-10018	06A	PARKS ILLINOIS AND MISSISSIPPI CANAL-STATE PARK. W69-10045	06E
GEOMETRIC PROGRAMMING NEW OPTIMIZATION TECHNIQUE FOR WATER RESOURCE ANALYSTS, W69-10020	06A	PARK DISTRICTS ABUTTING PUBLIC WATERS. W69-10183	06E
OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN, W69-10021	05G	ACQUISITION OF SUBMERGED LANDS FOR PUBLIC PARK PURPOSES. W69-10186	06E
DYNAMICS OF OBJECTS IRRIGATORY SYSTEMS REGULATION, W69-10025	03F	PATH OF POLLUTANTS INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT, W69-09891	05B
PLANNING APPROACHES TO WATER RESOURCES DEVELOPMENT AND UTILIZATION IN ISRAEL, W69-10026	06A	MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT	
ECONOMIC EVALUATION OF WATER PART 6, A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY, W69-10087	06B		
OXYGENATION OF IRON(II) IN CONTINUOUS REACTORS, W69-10293	05D		

WASHINGTON, D.C., AT LOW INFLOW CONDITIONS, W69-09914	05B	PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO, W69-10158	05C
PEPTIDES THE IMPORTANCE OF EXTRACELLULAR PRODUCTS OF ALGAE IN FRESHWATER, W69-10180	05C	TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD, W69-10181	02H
PERCOLATING WATER GROUNDWATER LEGISLATION, W69-09881	06E	PLANNING GEOLOGY FOR PLANNING IN MCHENRY COUNTY, W69-09912	06B
PERMAFROST PERMAFROST AND RELATED ENGINEERING PROBLEMS IN ALASKA, W69-10106	02C	IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL, W69-09936	06A
VELOCITY OF COMPRESSIVE WAVES IN POROUS MEDIA AT PERMAFROST TEMPERATURES, W69-10138	02C	THE FRESH WATER OF NEW YORK STATE ITS CONSERVATION AND USE, W69-09969	06B
PERMEABILITY IRMA'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE, W69-09909	02F	ECONOMICS AND THE ADMINISTRATION OF NATIONAL PLANNING, W69-09978	06B
PERMITS FISH AND WILDLIFE REGULATIONS. W69-10229	06E	DYNAMIC INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10014	06A
BLOOM V WATER RESOURCES COMMISSION (RELATIVE RIGHTS OF OWNERS OF ADJACENT UPLANDS). W69-10240	04A	FUTURE SUPPLIES OF WATER FOR DOMESTIC USE. W69-10039	06E
REUTER V DEPT OF NATURAL RESOURCES (ADMINISTRATIVE FINDING OF EFFECTS UPON WATER POLLUTION AS PREREQUISITE TO ISSUANCE OF DREDGING PERMITS). W69-10242	05G	SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE, W69-10292	06A
PERSONNEL MANAGEMENT STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN, W69-10018	06A	PLUMBING LEGAL ASPECTS OF CROSS CONNECTION INSPECTIONS, W69-10060	06E
PESTICIDE KINETICS DISTRIBUTION OF PESTICIDES IN SURFACE WATERS, W69-09884	05B	POLAND GROUND WATER SHARE OF THE WATER BALANCE AND AN EXAMPLE OF A RIVER CATCHMENT IN THE SEASIDE REGION (POLISH), W69-10104	02A
PESTICIDE REMOVAL DISTRIBUTION OF PESTICIDES IN SURFACE WATERS, W69-09884	05B	INVESTIGATION OF WATER RESERVOIR BOTTOM DENSITY USING RADIOMETRIC METHODS (POLISH), W69-10109	02J
PESTICIDES WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA. W69-10294	03F	POTENTIALLY BIGGEST RUNOFF FROM TORRENTIAL RAINFALLS (POLISH), W69-10112	02A
PHOSPHORUS ALGAE AND PHOSPHORUS IN LAKE MINNETONKA, W69-10167	05C	POLICY MAKING A FRAMEWORK FOR DEALING WITH THE URBAN ENVIRONMENT INTRODUCTORY STATEMENT, W69-10206	06B
RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA. W69-10172	02K	POLITICAL ASPECTS POLITICS AND LAND USE THE INDIANA SHORELINE OF LAKE MICHIGAN, W69-10199	06E
PHOSPHORUS COMPOUNDS REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA, W69-10176	05G	POLLUTION ABATEMENT WATER POLLUTION AND DISPOSAL OF WASTES. W69-10038	05B
PHOTOPHOSPHORYLATION THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHORYLATION, AND MACROMOLECULES IN BENTHIC ALGAL MATS, W69-10151	05C	WATER SUPPLY. W69-10246	05G
PHREATOPHYTES ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES, 1967, W69-10126	03B	TEXTILE INDUSTRY WARS ON STREAM WASTE POLLUTION, W69-10277	05G
PHYSICAL PROPERTIES RIVERS AND LAKES OF THE MONGOLIAN PEOPLE'S REPUBLIC (RUSSIAN). W69-09941	02E	POLYMERS POLYMERS FOR SEWER FLOW CONTROL, THE DEVELOPMENT AND DEMONSTRATION OF THE USE OF POLYMERS TO REDUCE OR ELIMINATE SEWER OVERFLOWS BY FLOW ENERGY REDUCTION. W69-10256	05C
PHYSIOLOGICAL ECOLOGY STUDIES ON MORPHOGENESIS IN A BLUE-GREEN ALGA. I. EFFECT OF INORGANIC NITROGEN SOURCES ON DEVELOPMENTAL MORPHOLOGY OF ANABAENA DOLIOLUM, W69-10177	05C	POROSITY IRMA'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE, W69-09909	02F
PHYTOPLANKTON EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO, W69-10158	05C	POOROUS MEDIA TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA 2, FINITE RESERVOIRS, W69-09926	08E
PIERS WATERWAYS AND MILLDAMS. W69-10008	06E	POTABLE WATER LEGAL ASPECTS OF CROSS CONNECTION INSPECTIONS, W69-10060	06E
PIPES LEGAL ASPECTS OF CROSS CONNECTION INSPECTIONS, W69-10060	06E	POTOMAC ESTUARY STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES, W69-09879	05B
PLANKTON FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY, W69-09901	02L	POTOMAC GROUP DEPOSITIONAL ENVIRONMENTS OF SUBSURFACE POTOMAC GROUP IN MARYLAND, W69-10113	02J
EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR		POTOMAC RIVER MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS, W69-09918	05B
		POTOMAC RIVER BASIN A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-09954	06E
		PRECIPITATION GAGES INSTRUMENTATION FOR SNOW GAGING -- YESTERDAY, TODAY, AND TOMORROW,	

W69-09992	07B	PROVIDENCE
GAMMA-TRANSMISSION PROFILING RADIOSO TOPE SNOW DENSITY AND DEPTHS GAGE,		STRAINER/FILTER TREATMENT OF COMBINED SEWER OVERFLOWS,
W69-09994	07B	W69-10254
ISOTOPE SNOW GAGES FOR DETERMINING HYDROLOGIC CHARACTERISTICS OF SNOWPACKS,		OSD
W69-09995	07B	PSEUDOMONAS
ISOTOPES -- A MULTIPURPOSE TOOL FOR FOREST WATERSHED RESEARCH,		PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL
W69-09996	07B	CHLORINATION AND ALGICIDES,
PORTABLE RADIOACTIVE ISOTOPE SNOW GAGES FOR PROFILING SNOWPACKS,		W69-10171
W69-09997	07B	05F
PRECIPITATION MANAGEMENT		PUBLIC ADMINISTRATION
A STUDY OF THE FEASIBILITY OF SOCIAL SCIENCE RESEARCH DESIGNED TO IDENTIFY AND ANALYZE SOCIAL RESPONSES TO PRECIPITATION MANAGEMENT OPERATIONS IN NEW ENGLAND,		ECONOMICS AND THE ADMINISTRATION OF NATIONAL PLANNING,
W69-10192	06B	W69-09978
PRECIPITATION (ATMOSPHERIC)		06B
THE RECENT 5-YEAR DROUGHT ON SCITUATE WATERSHED AND NEARBY DRAINAGE BASINS IN RHODE ISLAND AND MASSACHUSETTS,		PUBLIC BENEFITS
W69-10188	02E	WATER RECREATION - PUBLIC USE OF 'PRIVATE' WATERS,
PREDICTION		W69-10215
RESOURCE ALLOCATION WITH PROBABILISTIC INDIVIDUAL PREFERENCES,		06B
W69-09956	06C	PUBLIC CONTROL
PREFERENCES		GROUNDWATER LEGISLATION,
CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS,		W69-09981
W69-09979	06E	06E
PRESSURE		PUBLIC EXPENDITURES
DETERMINATION OF DYNAMIC PRESSURE OF WATER ON A DAM USING THE EHDA METHOD AND TAKING INTO CONSIDERATION THE DAM ELASTICITY (RUSSIAN),		SOME NOTES ON THE LINDAHL THEORY OF DETERMINATION OF PUBLIC EXPENDITURES,
W69-10099	08B	W69-09951
PRICING		06B
A PUBLIC CHOICE APPROACH TO PUBLIC UTILITY PRICING,		PUBLIC GOODS
W69-09962	06C	ON THE PURE THEORY OF PUBLIC GOODS,
PRIMARY PRODUCTIVITY		W69-09966
THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHORILATION, AND MACROMOLECULES IN BENTHIC ALgal MATS,		06C
W69-10151	05C	PUBLIC HEALTH
TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD,		GROUNDWATER LEGISLATION,
W69-10181	02H	W69-09981
PRIORITIES		06E
CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS,		WATER POLLUTION AND DISPOSAL OF WASTES,
W69-09979	06E	W69-10036
PROBABILITY		05B
PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES,		TESTING OF WATER SUPPLIES.
W69-09902	02A	W69-10040
PRODUCTION FUNCTIONS		06E
IRRIGATION WITH RESTRAINTS ON LAND AND WATER RESOURCES,		SANITARY PROVISIONS.
W69-10189	03F	W69-10300
PRODUCTIVITY		05F
TECHNOLOGICAL PROGRESS AND MICROECONOMIC THEORY,		PUBLIC LANDS
W69-09959	06B	SWAMP, SALINE, AND MEANDER LANDS OF STATE-PURCHASE FOR PUBLIC PARK OR FOREST PURPOSES.
PROJECT PLANNING		W69-10219
CAPITAL BUDGETING OF INTERRELATED PROJECTS		06E
SYNTHESIS,		PUBLIC OPINION
W69-09971	06A	GROUNDWATER LEGISLATION,
WATER DRAINAGE AND LEVEE DISTRICTS.		W69-09981
W69-10062	06E	06E
W69-10063	06E	PUBLIC UTILITY PRICING
PROJECTS		A PUBLIC CHOICE APPROACH TO PUBLIC UTILITY PRICING,
WATER RESOURCES RESEARCH INTERESTS IN THE SENIOR COLLEGES AND UNIVERSITIES OF NORTH CAROLINA.		W69-09962
W69-10083	09C	06C
INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA.		PUBLIC WANTS
W69-10084	09A	SOME NOTES ON THE LINDAHL THEORY OF DETERMINATION OF PUBLIC EXPENDITURES,
WATER RESOURCES RESEARCH CATALOG, VOLUME FOUR.		W69-09951
W69-10115	10	06B
PROPERTY VALUES		PUERTO RICO
UNITED STATES V 930.65 ACRES OF LAND IN JEFFERSON COUNTY (VALIDATION OF LAND WITHOUT WATER SUPPLY).		WATER RECORDS OF PUERTO RICO, 1958-63,
W69-10058	06E	W69-10134
PROTOCOL AGREEMENT		02E
THE COLUMBIA RIVER TREATY AND PROTOCOL AGREEMENT,		PULP WASTES
W69-10209	06E	JOINT MUNICIPAL AND SEMICHEMICAL PULPING WASTE TREATMENT, A PILOT STUDY EVALUATING COMBINED TREATMENT OF DOMESTIC SEWAGE AND WEAK SEMICHEMICAL PULPING AND PAPERMAKING WASTES.
PROTOZOA		W69-10253
EPIDEMIC GIARDIASIS AT A SKI RESORT,		05D
W69-10079	05C	QUANTITATIVE TECHNIQUES
		CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS,
		W69-09980
		06B
		ACTIVITY ANALYSIS IN WATER PLANNING,
		W69-09982
		06B
		RADIOACTIVE DATING
		URANIUM DISEQUILIBRIUM IN GROUNDWATER AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS,
		W69-09925
		02K
		RADIOACTIVE WASTES
		INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT,
		W69-09891
		05B
		RADIOACTIVITY
		A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND,
		W69-10150
		02L
		SELF-ABSORPTION OF C-14 RADIATION IN FRESHWATER OSTRACODS,
		W69-10166
		02H
		RADIOACTIVITY TECHNIQUES
		INVESTIGATION OF WATER RESERVOIR BOTTOM DENSITY USING RADIOMETRIC METHODS (POLISH),
		W69-10109
		02J
		THE APPLICATION OF MICRO-AUTORADIOGRAPHIC TECHNIQUES TO ECOLOGICAL STUDIES,
		W69-10163
		07B
		RADIOCHEMICAL ANALYSIS
		THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS,
		W69-10121
		02K
		RADIOISOTOPES

RAD-RES

SUBJECT INDEX

RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT.	05C	POWER TO ACQUIRE PIERS AND BEACHES.	06E
W69-10080		W69-10046	
NATURAL RADIODELMENTS IN SURFACE AND UNDERGROUND WATERS.	02K	WATER RECREATIONAL AREAS.	06E
W69-10118		W69-10055	
THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS.	02K	POWER TO ACQUIRE PIERS AND BEACHES.	04A
W69-10121		W69-10248	
THE APPLICATION OF MICRO-AUTORADIOGRAPHIC TECHNIQUES TO ECOLOGICAL STUDIES.	07B	REGIMEN	
W69-10163		GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECESSION IN THE NARVIKSKJOMEN DISTRICT, NORWAY,	
RADIOMETRY		W69-09924	02C
DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE.	07B	REGIONAL ANALYSIS	
W69-10140		THE REGIONAL MULTIPLIER--A CRITIQUE,	
RAILROADS		W69-09961	06B
DRAINAGE OF ROADBED.	06E	REGIONAL ECONOMICS A SURVEY,	06B
W69-09945		W69-09975	
CROSSING OF STREAMS BY RAILROADS.	06E	INTERREGIONAL INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS).	
W69-10175		W69-10013	06B
RAILROAD COMPANY MAY OPERATE FERRY.	06E	THE INTERREGIONAL DYNAMIC INPUT-OUTPUT PROGRAMMING MODEL.	
W69-10249		W69-10015	06B
RAINFALL		ECONOMIC EVALUATION OF WATER PART VI A DYNAMIC	
POTENTIALLY BIGGEST RUNOFF FROM TORRENTIAL RAINFALLS (POLISH).	02A	INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY,	
W69-10112		W69-10016	06A
OCCURRENCE OF SULFATE AND NITRATE IN RAINFALL.	05B	REGIONAL DEVELOPMENT	
W69-10153		THE REGIONAL MULTIPLIER--A CRITIQUE,	
RAINFALL-RUNOFF RELATIONSHIPS		W69-09961	06B
TOTAL RUNOFF TRAVEL TIME DURING THE FORMATION OF MIXED 'SURFACE-SUBSURFACE' RAIN FLOODS IN SMALL WATER COURSES.		REGIONAL ECONOMICS	
W69-09915	02A	THE REGIONAL MULTIPLIER--A CRITIQUE,	
GEOLGIC CONTROL OF RAINFALL-RUNOFF RELATIONS IN THE PEAK CREEK WATERSHED, PULASKI AND WYTHE COUNTIES, VIRGINIA.		W69-09961	06B
W69-10090	02A	REGIONAL MULTIPLIER	
INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS.		THE REGIONAL MULTIPLIER--A CRITIQUE,	
W69-10098	02A	W69-09961	06B
REAERATION		REGIONAL WASTE TREATMENT	
ARTIFICIAL DESTRATIFICATION IN RESERVOIRS OF THE CALIFORNIA STATE WATER PROJECT.		ECONOMIC EVALUATION OF FLOW AUGMENTATION A SYSTEMS ANALYSIS CASE STUDY,	
W69-09883	05C	W69-10190	05G
REASONABLE USE		REGRESSION ANALYSIS	
STANTON V TRUSTEES OF ST JOSEPH'S COLLEGE (RESPECTIVE RIGHTS OF UPSTREAM AND DOWNSTREAM RIPARIAN OWNERS WHEN UPSTREAM USE IS TO BE NON-RIPARIAN).		ON THE INTERPRETATION OF DISCRIMINANT ANALYSIS,	
W69-09968	05G	W69-09957	06A
CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS.		REGULATION	
W69-09979	06E	SEWAGE DISPOSAL SYSTEMS ON ISLANDS.	
RECLAMATION		W69-10034	06E
SEMPOR PROJECT-GENERAL PLAN.	08A	WATER POLLUTION AND DISPOSAL OF WASTES.	
W69-10100		W69-10035	05B
PARK DISTRICTS ABUTTING PUBLIC WATERS.		W69-10037	05B
W69-10183	06E	W69-10038	05B
RECOVERY(WASTE)		TESTING OF WATER SUPPLIES.	
INVESTIGATIONS INTO THE CENTRIFUGING OF WOOL-SCOURING LIQUORS FOR WOOL-GREASE RECOVERY.		W69-10040	06E
W69-10265	05G	RULES OF THE INTERNAL IMPROVEMENT FUND OF THE STATE OF FLORIDA SOVEREIGNTY SUBMERGED AND TIDAL LANDS IN COASTAL AND INTRACOASTAL WATERS.	
TREATMENT OF WOOL SCOUR EFFLUENT AND THE RECOVERY OF WOOL GREASE.		W69-10042	06E
W69-10266	05D	RELATIVE RIGHTS	
WOOL SCOUR EFFLUENT TREATMENT AND WOOL GREASE RECOVERY.		STANTON V TRUSTEES OF ST JOSEPH'S COLLEGE (RESPECTIVE RIGHTS OF UPSTREAM AND DOWNSTREAM RIPARIAN OWNERS WHEN UPSTREAM USE IS TO BE NON-RIPARIAN).	
W69-10268	05D	W69-09968	05G
REMOVING DETERGENTS FROM WASTE WATERS NEW LOW-COST METHODS.		BLOOM V WATER RESOURCES COMMISSION (RELATIVE RIGHTS OF OWNERS OF ADJACENT UPLANDS).	
W69-10275	05D	W69-10240	04A
FACTORS AFFECTING RECOVERY OF WAX FROM WOOL SCOURING LIQUORS.		REMOTE SENSING	
W69-10284	05G	MICROWAVE RADIOMETRIC SENSING OF SOIL MOISTURE CONTENT,	
AERATION RECOVERY OF LANOLIN FROM WOOL SCOUR LIQUORS.		W69-09916	07B
W69-10286	05G	INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS.	
RECREATION		W69-09932	07B
RESERVOIR LOCATION FOR URBAN RECREATION.		DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE.	
W69-10022	04C	W69-10140	07B
WATER RECREATION - PUBLIC USE OF "PRIVATE" WATERS.		RESEARCH AND DEVELOPMENT	
W69-10215	06B	TECHNOLOGICAL PROGRESS AND MICROECONOMIC THEORY,	
OPERATION OF WATERCRAFT.		W69-09959	06B
W69-10230	06E	WATER RESOURCES RESEARCH INTERESTS IN THE SENIOR COLLEGES AND UNIVERSITIES OF NORTH CAROLINA.	
RECREATION DEMAND		W69-10083	09C
POLITICS AND LAND USE THE INDIANA SHORELINE OF LAKE MICHIGAN.		INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA.	
W69-10199	06E	W69-10084	09A
RECREATION FACILITIES		WATER RESOURCES RESEARCH CATALOG, VOLUME FOUR.	
		W69-10115	10
		RESEARCH AND DEVELOPMENT FOR REUSE OF WATER,	
		W69-10198	05D

WATER POLICY THEMES AND PROBLEMS FOR THE 1960'S AND 1970'S SUMMARY AND CONTENT, W69-10200	068	RIPARIAN RIGHTS STANTON V TRUSTEES OF ST JOSEPH'S COLLEGE (RESPECTIVE RIGHTS OF UPSTREAM AND DOWNSTREAM RIPARIAN OWNERS WHEN UPSTREAM USE IS TO BE NON-RIPARIAN). W69-09968	05G
WATER RESOURCES RESEARCH, W69-10201	06D	CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS. W69-09979	06E
RESEARCH FACILITIES INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA. W69-10084	09A	CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS, W69-09980	06B
RESEARCH NEEDS THE FLOODPLAIN AND THE SEASHORE A COMPARATIVE ANALYSIS OF HAZARD-ZONE OCCUPANCE, W69-10204	06F	GROUNDWATER LEGISLATION. W69-09981	06E
RESEARCH ON NATURAL RESOURCES A REVIEW AND COMMENTARY, W69-10210	06D	CANALS AND WATERWAYS, RIVERS, LAKES, STREAMS. W69-10043	06E
RESERVOIR CONSTRUCTION 6816.5 ACRES OF LAND V UNITED STATES (VALUATION OF PROPERTY IN CONDEMNATION PROCEEDING). W69-09907	06E	WATER RECREATION - PUBLIC USE OF 'PRIVATE' WATERS, W69-10215	06B
RESERVOIR EVAPORATION EVAPORATION INVESTIGATIONS AT ELEPHANT BUTTE RESERVOIR IN NEW MEXICO, W69-09934	02D	LAKE MICHIGAN RIGHTS OF RIPARIAN OWNERS. W69-10218	06E
COMPARATIVE ESTIMATE OF METHODS OF COMPUTING EVAPORATION FROM BODIES OF WATER, W69-10131	02D	BLOOM V WATER RESOURCES COMMISSION (RELATIVE RIGHTS OF OWNERS OF ADJACENT UPLANDS). W69-10240	04A
RESERVOIR OPERATION ARTIFICIAL DESTRATIFICATION IN RESERVOIRS OF THE CALIFORNIA STATE WATER PROJECT, W69-09883	05C	RISKS RESOURCE ALLOCATION WITH PROBABILISTIC INDIVIDUAL PREFERENCES, W69-09956	06C
RESERVOIR SILTING SEDIMENTATION IN BROWNELL CREEK SUBWATERSHED NO. 1, NEBRASKA, W69-09946	04D	TAXATION AND RISK-TAKING AN EXPECTED UTILITY APPROACH, W69-09963	06B
RESERVOIR SITES RESERVOIR LOCATION FOR URBAN RECREATION, W69-10022	04C	RISK-TAKING TAXATION AND RISK-TAKING AN EXPECTED UTILITY APPROACH, W69-09963	06B
RESERVOIR STORAGE WATER CONSERVATION COMMISSION. W69-10068	06E	RIVER BASIN COMMISSIONS INTERSTATE WATER SANITATION BOARD. W69-10297	05G
REGIONAL WATER DISTRIBUTION DISTRICT ACT. W69-10234	04A	RIVER BASINS WATERSHED MANAGEMENT EFFECTS ON BASIN DEVELOPMENT, W69-09999	02A
RESERVOIRS INVESTIGATION OF WATER RESERVOIR BOTTOM DENSITY USING RADIOMETRIC METHODS (POLISH). W69-10109	02J	OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN, W69-10021	05G
RESOURCE ALLOCATION A NORMATIVE THEORY OF TRANSFERS, W69-09960	06B	DEVELOPED EQUATION OF THE WATER BALANCE (POLISH), W69-10108	02A
ON THE PURE THEORY OF PUBLIC GOODS, W69-09966	06C	RIVER FLOW GROUND WATER SHARE OF THE WATER BALANCE AND AN EXAMPLE OF A RIVER CATCHMENT IN THE SEASIDE REGION (POLISH). W69-10104	02A
INTERREGIONAL INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10013	06B	RIVERS NATURE OF TURBIDITY IN THE ILLINOIS RIVER, W69-09885	02J
THE INTERREGIONAL DYNAMIC INPUT-OUTPUT PROGRAMMING MODEL, W69-10015	06B	RIVERS AND LAKES OF THE MONGOLIAN PEOPLE'S REPUBLIC (RUSSIAN), W69-09941	02E
DISCRETE DYNAMIC PROGRAMMING AND CAPITAL ALLOCATION, W69-10017	06C	GEOCHEMICAL EVOLUTION OF OUED SAOURA (NORTHWESTERN SAHARA) WATERS (FRENCH), W69-10114	02K
ADVOCACY AND RESOURCE ALLOCATION DECISIONS IN THE PUBLIC SECTOR, W69-10203	06B	PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE, W69-10139	05C
RESOURCE DEVELOPMENT PLANNING APPROACHES TO WATER RESOURCES DEVELOPMENT AND UTILIZATION IN ISRAEL, W69-10026	06A	EUTROPHICATION OF LAKES AND RIVERS ITS ORIGIN AND PREVENTION (IN GERMAN), W69-10170	05C
RESOURCES TECHNOLOGICAL PROGRESS AND MICROECONOMIC THEORY, W69-09959	06B	RIVERS AND HARBORS ACT WHITE RIVER NAVIGATION DISTRICT COMMISSION. W69-10235	04A
A FRAMEWORK FOR DEALING WITH THE URBAN ENVIRONMENT INTRODUCTORY STATEMENT, W69-10206	06B	ROAD CONSTRUCTION BRADSHAW V STATE HIGHWAY COMM'R (REQUIREMENT OF LANDOWNERS TO MITIGATE CONDEMNATION DAMAGES). W69-10237	04C
RESPIRATION ALGAL RESPIRATION IN A EUTROPHIC ENVIRONMENT, W69-10159	05B	STREAM CAVING AND ROAD CONSTRUCTION. W69-10299	04C
RESTRICTED USE GROUND WATER CONSERVATION. W69-10298	04B	ROCK MECHANICS ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION, W69-09927	08E
RETURN(MONETARY) DISCRETE DYNAMIC PROGRAMMING AND CAPITAL ALLOCATION, W69-10017	06C	ROCK PROPERTIES ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION, W69-09927	08E
RIGHT-OF-WAY PACKET AND NAVIGATION COMPANIES--COAL AND STONE COMPANIES. W69-10075	06E	SUMMARY OF HYDROLOGIC AND PHYSICAL PROPERTIES OF ROCK AND SOIL MATERIALS, AS ANALYZED BY THE HYDROLOGIC LABORATORY OF THE U.S. GEOLOGICAL SURVEY, 1948-60, W69-10143	02J
LEVEE AND DRAINAGE DISTRICTS. W69-10076	06E	RUNOFF POSSIBLY BIGGEST RUNOFF FROM TORRENTIAL RAINFALLS (POLISH),	02A

W69-10112	02A	W69-10133	02K
THE RECENT 5-YEAR DROUGHT ON SCITUATE WATERSHED AND NEARBY DRAINAGE BASINS IN RHODE ISLAND AND MASSACHUSETTS, W69-10188	02E	SEALANTS IMPROVED SEALANTS FOR INFILTRATION CONTROL, THE DEVELOPMENT AND DEMONSTRATION OF MATERIALS TO REDUCE OR ELIMINATE WATER INFILTRATION INTO SEWAGE, W69-10255	05G
RUNOFF FORECASTING TOTAL RUNOFF TRAVEL TIME DURING THE FORMATION OF MIXED 'SURFACE-SUBSURFACE' RAIN FLOODS IN SMALL WATER COURSES, W69-09915	02A	SEDIMENT MOVEMENT SEDIMENT--ITS CONSEQUENCES AND CONTROL, W69-10003	02J
IDENTIFICATION OF SPECTRAL CHARACTERISTICS OF HYDROLOGICAL SERIES BY A MODIFICATION OF THE GRENADE-ROSSENBLATT METHOD (RUSSIAN), W69-10096	02E	SEDIMENT TRANSPORT SEDIMENT--ITS CONSEQUENCES AND CONTROL, W69-10003	02J
SHORT-RANGE FORECASTING OF LOWLAND-RIVER RUNOFF, W69-10146	02A	SEDIMENT TRAP EFFICIENCY SEDIMENTATION IN BROWNELL CREEK SUBWATERSHED NO. 1, NEBRASKA, W69-09946	04D
SALTINE LAKES SOME FEATURES OF SALINE LAKES IN CENTRAL WASHINGTON, W69-10165	02H	SEDIMENTATION SEDIMENTATION IN BROWNELL CREEK SUBWATERSHED NO. 1, NEBRASKA, W69-09946	04D
SANDS REMOVAL OF SAND AND GRAVEL FROM NAVIGABLE WATERS AND SALE OR LEASE OF MINERALS ON STATE LANDS, W69-10074	06E	SEDIMENT--ITS CONSEQUENCES AND CONTROL, W69-10003	02J
DEPOSITIONAL ENVIRONMENTS OF SUBSURFACE POTOMAC GROUP IN MARYLAND, W69-10113	02J	DEPOSITIONAL ENVIRONMENTS OF SUBSURFACE POTOMAC GROUP IN MARYLAND, W69-10113	02J
A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND, W69-10150	02L	SEDIMENTOLOGY DEPOSITIONAL ENVIRONMENTS OF SUBSURFACE POTOMAC GROUP IN MARYLAND, W69-10113	02J
SANDSTONES ARAGONITE-COMPACTED SANDSTONE FROM OUTER CONTINENTAL SHELF OFF DELAWARE BAY SUBMARINE LITHIFICATION MECHANISM YIELDS PRODUCT RESEMBLING BEACHROCK, W69-09908	02L	SEDIMENTS OBSERVATIONS OF GASES IN CHESAPEAKE BAY SEDIMENTS, W69-09900	02K
IRMAY'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE, W69-09909	02F	THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS, W69-10121	02K
SANITARY ENGINEERING WATER POLLUTION AND DISPOSAL OF WASTES, W69-10036	05B	SEDIMENTS FROM DANISH LAKES, W69-10174	02H
W69-10037	05B	SEDIMENT-WATER INTERFACES THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS, W69-10121	02K
SANITARY PROVISIONS. W69-10300	05F	SEISMIC PROPERTIES VELOCITY OF COMPRESSIVE WAVES IN POROUS MEDIA AT PERMAFROST TEMPERATURES, W69-10138	02C
SATURATION IRMAY'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE, W69-09909	02F	SEISMIC STUDIES VELOCITY OF COMPRESSIVE WAVES IN POROUS MEDIA AT PERMAFROST TEMPERATURES, W69-10138	02C
SATURATION FACTOR IRMAY'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE, W69-09909	02F	SELF-ABSORPTION SELF-ABSORPTION OF C-14 RADIATION IN FRESHWATER OSTRACODS, W69-10166	02H
SAW MILLS DEPOSIT OF SAWMILL WASTE IN WATERS, W69-10222	05G	SEWAGE WATER POLLUTION AND DISPOSAL OF WASTES, W69-10035	05B
SAWDUST DEPOSIT OF SAWMILL WASTE IN WATERS, W69-10222	05G	IMPROVED SEALANTS FOR INFILTRATION CONTROL, THE DEVELOPMENT AND DEMONSTRATION OF MATERIALS TO REDUCE OR ELIMINATE WATER INFILTRATION INTO SEWAGE, W69-10255	05G
SCHEDULING CALENDAR - DAY C P M, W69-10009	06A	SEWAGE DISPOSAL SEWAGE DISPOSAL SYSTEMS ON ISLANDS, W69-10034	06E
SCITUATE WATERSHED IN RHODE ISLAND THE RECENT 5-YEAR DROUGHT ON SCITUATE WATERSHED AND NEARBY DRAINAGE BASINS IN RHODE ISLAND AND MASSACHUSETTS, W69-10188	02E	SEWAGE TREATMENT JOINT MUNICIPAL AND SEMICHEMICAL PULPING WASTE TREATMENT, A PILOT STUDY EVALUATING COMBINED TREATMENT OF DOMESTIC SEWAGE AND WEAK SEMICHEMICAL PULPING AND PAPERMAKING WASTES, W69-10253	05D
SCOURING WASTE INVESTIGATIONS INTO THE CENTRIFUGING OF WOOL-SCOURING LIQUORS FOR WOOL-GREASE RECOVERY, W69-10265	05G	STRAINER/FILTER TREATMENT OF COMBINED SEWER OVERFLOWS, W69-10254	05D
TREATMENT OF WOOL SCOUR EFFLUENT AND THE RECOVERY OF WOOL GREASE, W69-10266	05D	A REVIEW OF THE LITERATURE OF 1964 ON WASTE WATER AND WATER POLLUTION CONTROL, W69-10271	05D
WOOL SCOUR EFFLUENT TREATMENT AND WOOL GREASE RECOVERY, W69-10268	05D	A REVIEW OF THE LITERATURE OF 1963 ON WASTE WATER AND WATER POLLUTION CONTROL, W69-10272	05D
EFFLUENT TREATMENT PLANTS INSTALLATION AT SPINNING WORKS IN DEVON, W69-10273	05D	SEWER LINES POLYMERS FOR SEWER FLOW CONTROL, THE DEVELOPMENT AND DEMONSTRATION OF THE USE OF POLYMERS TO REDUCE OR ELIMINATE SEWER OVERFLOWS BY FLOW ENERGY REDUCTION, W69-10256	05C
FACTORS AFFECTING RECOVERY OF WAX FROM WOOL SCOURING LIQUORS, W69-10284	05G	SHEAR STRENGTH MECHANICS AND RATES OF NATURAL SOIL CREEP, W69-09988	07B
AERATION RECOVERY OF LANOLIN FROM WOOL SCOUR LIQUORS, W69-10286	05G	SHENANDOAH A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-09954	06E
SEA WATER DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER, W69-10125	02K		
ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES,			

SHORES		
POWER TO ACQUIRE AND DISPOSE OF PROPERTY RESTRICTIONS AS TO DISPOSITION OF WATER FRONT.		
W69-09889	06E	
SILICA		
SILICA IN AQUEOUS SOLUTIONS, W69-10122	01B	
SILICATES		
SILICA IN AQUEOUS SOLUTIONS, W69-10122	01B	
SIMULATION		
SIMULATION OF INDIVIDUAL AND GROUP BEHAVIOR, W69-09950	06A	
SIMULATION ANALYSIS		
MONTE CARLO SIMULATION OF WASTE DISCHARGE, W69-09880	05B	
SIMULATION OF ECONOMIC SYSTEMS, W69-09949	06A	
CONJUNCTIVE USE OF GROUND AND SURFACE WATERS, W69-10012	06A	
PLANNING APPROACHES TO WATER RESOURCES DEVELOPMENT AND UTILIZATION IN ISRAEL, W69-10026	06A	
SINKING AGENTS		
CHEMICAL TREATMENT OF OIL SLICKS. A STATUS REPORT ON THE USE OF CHEMICALS AND OTHER MATERIALS TO TREAT OIL SPILLED ON WATER. W69-10252	05D	
SKELETONEMA TROPICUM		
THE RELATIONSHIP OF THE DISTRIBUTION OF THE DIATOM SKELETONEMA TROPICUM TO TEMPERATURE, W69-10162	05C	
SKIING		
EPIDEMIC GIAUDIASIS AT A SKI RESORT, W69-10079	05C	
SLOPE STABILITY		
MECHANICS AND RATES OF NATURAL SOIL CREEP, W69-09986	07B	
SMALL WATERSHEDS		
BASIC DATA REPORT NO 3 FOR RESEARCH ON FLOOD FREQUENCY FOR SMALL DRAINAGE AREAS, W69-09895	02E	
SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958-SEPT 1967), W69-10093	02E	
SNOW		
GAMMA-TRANSMISSION PROFILING RADIOSOPOKE SNOW DENSITY AND DEPTH GAGE, W69-09994	07B	
TRANSPORT OF INTERCEPTED SNOW FROM TREES DURING SNOW STORMS, W69-09998	02C	
SNOW DENSITY		
ISOTOPIC SNOW GAGES FOR DETERMINING HYDROLOGIC CHARACTERISTICS OF SNOWPACKS, W69-09995	07B	
SNOW MEASUREMENT		
INSTRUMENTATION FOR SNOW GAGING -- YESTERDAY, TODAY, AND TOMORROW, W69-09992	07B	
SNOW MEASUREMENTS		
MEASUREMENT OF SNOWPACK PROFILES WITH RADIOACTIVE ISOTOPES, W69-10001	07B	
SNOW SURVEYS		
INVESTIGATION OF A METHOD OF MEASURING SNOW STORAGE BY USING THE GAMMA RADIATION OF THE EARTH, W69-10142	02C	
SNOWMELT		
SNOW EVAPORATION REDUCTION MIGRATION OF EVAPORATION SUPPRESSANTS THROUGH SNOW, W69-09993	07B	
SNOWPACKS		
PORTABLE RADIOACTIVE ISOTOPIC SNOW GAGES FOR PROFILING SNOWPACKS, W69-09997	07B	
SOAPs		
SURFACE-ACTIVE AGENTS IN TEXTILE PROCESSES AND THEIR EFFECT ON EFFLUENTS, W69-10260	05D	
TREATMENT OF WOOL SCOUR EFFLUENT AND THE RECOVERY OF WOOL GREASE W69-10266	05D	
SODIUM HYDROXIDE		
WASTE-TREATMENT EXPERIENCE REPORTED, W69-10281	05D	
SODIUM HYDROXIDE		
WASTE TREATMENT AT CANNON MILLS, W69-10282	05D	
SOIL CONSERVATION		
SEDIMENT--ITS CONSEQUENCES AND CONTROL, W69-10003	02J	
WATER RIGHTS AND ADMINISTRATION WITH RESPECT TO SOIL AND WATER CONSERVATION, W69-10221	06E	
DEPARTMENT OF NATURAL RESOURCES, W69-10228	06E	
SOIL EROSION		
SEDIMENT-- ITS CONSEQUENCES AND CONTROL, W69-10003	02J	
SOIL MOISTURE		
EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT, W69-09986	07B	
MEASURING MOISTURE NEAR SOIL SURFACE. . . MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE, W69-09987	07B	
ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS, W69-10130	02G	
SOIL MOISTURE METERS		
MICROWAVE RADIOMETRIC SENSING OF SOIL MOISTURE CONTENT, W69-09916	07B	
EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT, W69-09986	07B	
MEASURING MOISTURE NEAR SOIL SURFACE. . . MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE, W69-09987	07B	
SOIL STRENGTH		
MECHANICS AND RATES OF NATURAL SOIL CREEP, W69-09988	07B	
SOIL WATER		
PERMAFROST AND RELATED ENGINEERING PROBLEMS IN ALASKA, W69-10106	02C	
SOIL WATER MOVEMENT		
MOISTURE MOVEMENT TO A FREEZING FRONT, W69-09928	02G	
SOILS		
INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR, W69-10132	02A	
SOIL-WATER-PLANT RELATIONSHIPS		
ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS, W69-10130	02G	
SOLUTES		
INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT, W69-09891	05B	
WATER QUALITY OF MOUNTAIN WATERSHEDS, W69-09943	05B	
SOUTH CAROLINA		
WATERCOURSES AND CUTS GENERALLY, W69-10041	06E	
SOUTH DAKOTA		
HYDROLOGY OF A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA, W69-10110	02E	
SOUTHEAST US		
WATER RIGHTS POLICIES IN THE SOUTHEAST, W69-10220	06B	
SPAIN		
USE OF A MATHEMATICAL MODEL IN THE HYDROLOGIC STUDY AS APPLIED TO THE VEGA DE GRENADE OF SPAIN (FRENCH), W69-10147	02F	
SPILLWAYS		
METHOD OF DETERMINING THE DISCHARGE OF TWO-LEVEL SPILLWAYS, W69-10129	08B	
SPORT FISHING		
EFFECTS OF SURFACE MINING ON THE FISH AND WILDLIFE RESOURCES OF THE UNITED STATES, W69-10137	05C	
ECONOMIC ASPECTS OF PRIVATELY OWNED FISHING ENTERPRISES IN WISCONSIN, W69-10191	06D	
SPRAYING		
STUDY OF IRRIGATION BY SPRINKLING (FRENCH), W69-09903	03F	

SPRINGS	STRFAMPLOW
INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS, W69-09932	WATER QUALITY OF MOUNTAIN WATERSHEDS, W69-09943
EFFECT OF TECTONIC STRUCTURE ON THE OCCURRENCE OF GROUND WATER IN THE BASALT OF THE COLUMBIA RIVER GROUP OF THE DALLES AREA, OREGON AND WASHINGTON, W69-10107	02B
W69-10107	02F
STABLE ISOTOPES	SURFACE-WATER DISCHARGE AND GROUND-WATER LEVELS IN THE EAST FORK RIVER AREA, SWEETWATER COUNTY, WYOMING, W69-10097
ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES, W69-10133	02E
W69-10133	02K
STANDARDS	POTENTIALLY BIGGEST RUNOFF FROM TERRITORIAL RAINFALLS (POLISH), W69-10112
A REVIEW OF THE LITERATURE OF 1964 ON WASTE WATER AND WATER POLLUTION CONTROL, W69-10271	02A
W69-10271	05D
A REVIEW OF THE LITERATURE OF 1963 ON WASTE WATER AND WATER POLLUTION CONTROL, W69-10272	02D
W69-10272	05D
WATER IN TEXTILE PROCESSING, W69-10278	02G
W69-10278	05G
STARCH	STREAMFLOW FORECASTING SHORT-RANGE FORECASTING OF LOWLAND-RIVER RUNOFF, W69-10146
KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS, W69-10258	02A
W69-10258	05D
BIOLOGICAL OXYGEN DEMAND (BOD) OF STARCH AND STARCH DERIVATIVES (IN DUTCH), W69-10269	02D
W69-10269	05D
WASTE-TREATMENT EXPERIENCE REPORTED, W69-10281	02D
W69-10281	05D
WASTE TREATMENT AT CANNON MILLS, W69-10282	02D
W69-10282	05D
CMC KAYOED STREAM POLLUTION. W69-10287	02D
W69-10287	05D
STATE GOVERNMENTS	STRESS ANALYSIS TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA FINITE RESERVOIRS, W69-09926
TRENDS IN WATER RIGHTS LEGISLATION. W69-10217	02E
W69-10217	06B
STATE JURISDICTION	STREAMS RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT, W69-10080
STATE GOVERNMENT A FORCE IN WATER DEVELOPMENT, W69-10193	02E
W69-10193	06E
STATISTICAL METHODS	STRESS ANALYSIS TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA FINITE RESERVOIRS, W69-09926
PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES, W69-09902	02A
W69-09902	06B
THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES, W69-09938	02A
W69-09938	06A
INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS, W69-10098	02A
W69-10098	06B
STATISTICAL MODELS	SUBSIDENCE LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA, W69-10135
STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES, W69-09879	02B
W69-09879	05B
MONTE CARLO SIMULATION OF WASTE DISCHARGE, W69-09880	02B
W69-09880	05B
STEINER MODEL	SUBSURFACE RUNOFF TOTAL RUNOFF TRAVEL TIME DURING THE FORMATION OF MIXED "SURFACE-SUBSURFACE" RAIN FLOODS IN SMALL WATER COURSES, W69-09915
CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS, W69-09980	02A
W69-09980	06B
ACTIVITY ANALYSIS IN WATER PLANNING, W69-09982	02B
W69-09982	06B
STOCHASTIC PROCESSES	SULFATES ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES, W69-10133
PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES, W69-09902	02A
W69-09902	06C
STORM RUNOFF	OCCURRENCE OF SULFATE AND NITRATE IN RAINFALL, W69-10153
SELECTED URBAN STORM WATER RUNOFF ABSTRACTS. W69-10085	02B
W69-10085	04C
STRAINERS	SULFUR ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES, W69-10133
STRAINER/FILTER TREATMENT OF COMBINED SEWER OVERFLOWS, W69-10254	02B
W69-10254	05D
STRATIFICATION	SURFACE WATERS DISTRIBUTION AND CIRCULATION OF THE MAJOR ELEMENTS IN SURFACE WATERS OF ITALY, W69-09922
ARTIFICIAL DESTRATIFICATION IN RESERVOIRS OF THE CALIFORNIA STATE WATER PROJECT, W69-09883	02A
W69-09883	05C
STREAM CAVING	SURFACE WATERS DISTRIBUTION AND CIRCULATION OF THE MAJOR ELEMENTS IN SURFACE WATERS OF ITALY, W69-09922
STREAM CAVING AND ROAD CONSTRUCTION. W69-10299	02B
W69-10299	04C
STREAM GAGES	SURFACE WATERS DISTRIBUTION AND CIRCULATION OF THE MAJOR ELEMENTS IN SURFACE WATERS OF ITALY, W69-09922
FLOW MEASURING STRUCTURES IN THE HYDROLOGICAL OBSERVATION NETWORK, W69-09929	02B
W69-09929	05B
DISCHARGE MEASUREMENTS AT GAGING STATIONS, W69-10111	02B
W69-10111	07B
STREAM IMPROVEMENT	SURFACE-GROUNDWATER RELATIONSHIPS CONJUNCTIVE USE OF GROUND AND SURFACE WATERS, W69-10012
OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS, W69-10024	02B
W69-10024	05B
SURVEYS	SURFACTANTS BIODEGRADABLE SURFACTANTS FOR THE TEXTILE INDUSTRY, W69-10259
RECORDED OBSERVATIONS ON THE INFLUENCE OF CLOUDINESS AND	05D
	SURFACE-ACTIVE AGENTS IN TEXTILE PROCESSES AND THEIR EFFECT ON EFFLUENTS, W69-10260
	UNION CARBIDE'S BIODEGRADABLE SURFACTANTS FIGHT POLLUTION, W69-10262
	05G

WIND VELOCITY ON THE BRIGHTNESS OF THE DAYLIGHT SKY ABOVE THE WATER SPACE (RUSSIAN), W69-09899	02B	GROUNDWATER IN OGALLALA FORMATION IN THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO, W69-09913	02F
GRAVIMETRIC ESTIMATION OF DEPTH TO AQUIFERS IN THE HAZEVA AREA, ARAVA VALLEY, ISRAEL, W69-09917	02F	TEXTILE WASTES WATER POLLUTION AND WASTE CONTROL IN THE TEXTILE INDUSTRY, W69-10257	05D
DISTRIBUTION AND CIRCULATION OF THE MAJOR ELEMENTS IN SURFACE WATERS OF ITALY, W69-09922	02K	BIOLOGICAL TREATMENT OF TEXTILE EFFLUENTS, W69-10261	05D
THE AVAILABILITY OF GROUNDWATER FROM THE POTOMAC FORMATION IN THE CHESAPEAKE AND DELAWARE CANAL AREA, DELAWARE, W69-09942	02F	PURIFICATION OF INDUSTRIAL WASTES (IN GERMAN), W69-10264	05D
WATER-LEVEL CHANGES 1964-1968, NORTHERN HIGH PLAINS OF COLORADO, W69-10094	02F	TEXTILE INDUSTRY WAES ON STREAM WASTE POLLUTION, W69-10277	05G
WATER RESOURCES OF THE JOPLIN AREA, MISSOURI, W69-10095	02F	CHEMICAL PURIFICATION OF VARIOUS INDUSTRIAL WASTE WATERS (IN GERMAN), W69-10280	05D
SWEDEN		WASTE-TREATMENT EXPERIENCE REPORTED, W69-10281	05D
COMPARISONS IN RESOURCE MANAGEMENT, W69-09952	06B	THREE-STAGE LEAST SQUARES ALTERNATIVE ASYMPTOTIC TESTS OF SIGNIFICANCE AND RELATED ASPECTS OF 2SLS AND 3SLS ESTIMATED PARAMETERS, W69-09953	06A
SWIMMING POOLS		TIDES RESISTANCE TO REVERSING FLOWS OVER MOVABLE BEDS, W69-09892	02E
PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES, W69-10171	05F	TIME SERIES ANALYSIS PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES, W69-09902	02A
SWITZERLAND		THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES, W69-09938	06A
ON CONTROL OF LAKE EUTROPHICATION EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS--(IN GERMAN), W69-10164	05C	IDENTIFICATION OF SPECTRAL CHARACTERISTICS OF HYDROLOGICAL SERIES BY A MODIFICATION OF THE GRENDANDER-ROSENBLATT METHOD (RUSSIAN), W69-10096	02E
SYNTHETIC HYDROLOGY		TOLLS WATERCOURSES AND CUTS GENERALLY, W69-10041	06E
NUMERICAL SIMULATION OF WAVE-CREST MOVEMENT IN RIVERS AND ESTUARIES, W69-09919	02E	TRACE ELEMENTS DISTRIBUTION AND CIRCULATION OF THE MAJOR ELEMENTS IN SURFACE WATERS OF ITALY, W69-09922	02K
HYDROLOGIC DISTRIBUTIONS RESULTING FROM MIXED POPULATIONS AND THEIR COMPUTER SIMULATION, W69-09935	07C	ASPECTS OF THE OCCURRENCE AND MIGRATION OF NIOBIUM, BERYLLIUM, AND RARE EARTHS IN NATURAL ALKALINE WATERS, W69-10116	02K
THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES, W69-09938	06A	TRACERS INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT, W69-09891	05B
SYSTEM ANALYSIS		DISCHARGE MEASUREMENT IN OPEN CHANNELS BY DILUTION METHODS (FRENCH), W69-09905	07B
ECONOMIC EVALUATION OF FLOW AUGMENTATION A SYSTEMS ANALYSIS CASE STUDY, W69-10190	05G	MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS, W69-09914	05B
SYSTEMS ANALYSIS		URANIUM DISEQUILIBRIUM IN GROUNDWATER AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS, W69-09925	02K
MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER, W69-09918	06A	TRANSFERS A NORMATIVE THEORY OF TRANSFERS, W69-09960	06B
SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL BORROWING, W69-09976	06A	TRANSITION FLOW IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS, W69-10019	02F
GEOMETRIC PROGRAMMING NEW OPTIMIZATION TECHNIQUE FOR WATER RESOURCE ANALYSTS, W69-10020	06A	TRANSMISSIVITY CONJUNCTIVE USE OF GROUND AND SURFACE WATERS, W69-10012	06A
PLANNING APPROACHES TO WATER RESOURCES DEVELOPMENT AND UTILIZATION IN ISRAEL, W69-10026	06A	IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS, W69-10019	02F
TAXES		TRANSPORTATION CROSSING OF STREAMS BY RAILROADS, W69-10175	06E
TAXATION AND RISK-TAKING AN EXPECTED UTILITY APPROACH, W69-09963	06B	ARKANSAS WATERWAYS COMMISSION. W69-10236	04A
TECHNOLOGICAL PROGRESS		RAILROAD COMPANY MAY OPERATE FERRY, W69-10249	06E
TECHNOLOGICAL PROGRESS AND MICROECONOMIC THEORY, W69-09959	06B	STREAMFLOW FORECASTING THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES, W69-09938	06A
TECHNOLOGY		TREATMENT FACILITIES BIOLOGICAL TREATMENT OF TEXTILE EFFLUENTS, W69-10261	05D
TECHNOLOGICAL PROGRESS AND MICROECONOMIC THEORY, W69-09959	06B	EFFLUENT TREATMENT PLANTS INSTALLATION AT SPINNING WORKS IN DEVON.	
TEMPERATURE			
TEMPERATURE OPTIMA FOR ALGAL DEVELOPMENT IN YELLOWSTONE AND ICELAND HOT SPRINGS, W69-10160	05C		
THE RELATIONSHIP OF THE DISTRIBUTION OF THE DIATOM SKELETONEMA TROPICUM TO TEMPERATURE, W69-10162	05C		
TENNESSEE RIVER			
TENNESSEE TOMBIGBEE WATERWAY DEVELOPMENT COMPACT. W69-10010	06E		
TEST PROCEDURES			
Biodegradable surfactants for the textile industry, W69-10259	05D		
TESTING			
SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958, W69-09939	08A		
TEXAS			
WATER REUSE A TEXAS NECESSITY, W69-09882	05D		

W69-10273	05D	ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM, W69-10119	02K
BLEACHERY WASTES TREATED BY NUTRIENTS AND HIGH-RATE FILTER PLANT. W69-10289	05D	ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS, W69-10120	02K
WASTES TREATMENT PLANT FOR COTTON FINISHING INDUSTRY, SAYLESVILLE RHODE ISLAND. W69-10290	05D	ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K
TURBIDITY NATURE OF TURBIDITY IN THE ILLINOIS RIVER, W69-09885	02J	DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER, W69-10125	02K
WATER QUALITY OF MOUNTAIN WATERSHEDS, W69-09943	05B	COMPARATIVE ESTIMATE OF METHODS OF COMPUTING EVAPORATION FROM BODIES OF WATER, W69-10131	02D
TURBULENT FLOW DISPERSION OF FLOATING PARTICLES IN UNIFORM CHANNEL FLOW, W69-09887	02J	INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR, W69-10132	02A
FRICITION-FACTORS FOR FLAT-BED FLOWS IN SAND CHANNELS, W69-09893	02E	ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES, W69-10133	02K
TWO-STAGE LEAST SQUARES ALTERNATIVE ASYMPTOTIC TESTS OF SIGNIFICANCE AND RELATED ASPECTS OF 2SLS AND 3SLS ESTIMATED PARAMETERS, W69-09953	06A	PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE, W69-10139	05C
UNIFIED BASIN DEVELOPMENT THE COLUMBIA RIVER TREATY AND PROTOCOL AGREEMENT, W69-10209	06E	EXPERIMENTAL PALEOHYDROLOGIC INVESTIGATIONS, W69-10141	02E
UNIT HYDROGRAPHS INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS, W69-10098	02A	SHORT-RANGE FORECASTING OF LOWLAND-RIVER RUNOFF, W69-10146	02A
UNITED STATES ILLINOIS AND MISSISSIPPI CANAL-STATE PARK. W69-10045	06E	UTILITY THEORY TAXATION AND RISK-TAKING AN EXPECTED UTILITY APPROACH, W69-09963	06B
IMPROVEMENT DISTRICTS OF RIVER WATER - DRAINAGE AND LEVEE DISTRICTS. W69-10066	06E	VARIABILITY OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS, W69-10024	05B
UNSTEADY FLOW UNSTEADY CIRCULATION IN SHALLOW LAKES, W69-09886	02H	VEGETATION EFFECTS HYDROLOGY OF FOREST LANDS AND RANGELANDS, W69-10002	02A
USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW PROBLEMS IN AQUIFER SYSTEMS, W69-09937	07C	FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER, W69-10004	03B
DYNAMICS OF OBJECTS IRRIGATORY SYSTEMS REGULATION, W69-10025	03F	REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE-LEHIGH EXPERIMENTAL FOREST, W69-10005	02A
URANIUM RADIOISOTOPES URANIUM DISEQUILIBRIUM IN GROUNDWATER AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS, W69-09925	02K	TECHNIQUES IN GRASSLAND WATERSHED RESEARCH, W69-10007	02A
ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS, W69-10117	02K	ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS, W69-10130	02G
URBAN ENVIRONMENT A FRAMEWORK FOR DEALING WITH THE URBAN ENVIRONMENT INTRODUCTORY STATEMENT, W69-10206	06B	VERMONT DAMS, W69-10027	06E
URBAN HYDROLOGY SELECTED URBAN STORM WATER RUNOFF ABSTRACTS. W69-10085	04C	DEPARTMENT OF WATER RESOURCES, W69-10032	06E
URBANIZATION GEOLOGY FOR PLANNING IN MCHENRY COUNTY, W69-09912	06B	DEPOSIT OF SAWMILL WASTE IN WATERS, W69-10222	05G
WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN, W69-09947	05G	CONNECTICUT RIVER FLOOD CONTROL COMPACT, W69-10224	04A
SELECTED URBAN STORM WATER RUNOFF ABSTRACTS. W69-10085	04C	DRAINAGE OF LOW LANDS. W69-10225	04A
FLOODS OF JULY 2, 1968, IN JACKSON, MISSISSIPPI, W69-10101	02E	VIRGINIA GEOLOGIC CONTROL OF RAINFALL-RUNOFF RELATIONS IN THE PEAK CREEK WATERSHED, PULASKI AND WYTHE COUNTIES, VIRGINIA, W69-10090	02A
USSR INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR, W69-09920	02D	BRADSHAW V STATE HIGHWAY COMM'R (REQUIREMENT OF LANDOWNERS TO MITIGATE CONDEMNATION DAMAGES), W69-10237	04C
DETERMINATION OF THE SEASONAL AND MONTHLY EVAPORATION NORMALS FROM AGRICULTURAL FIELDS FROM OBSERVATIONS AT A NETWORK OF STATIONS, W69-09921	02D	VISCOSITY FLOW VISCOSITY DISSIPATION IN EXTERNAL NATURAL CONVECTION FLOWS, W69-10091	01A
IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL, W69-09936	06A	WASHINGTON EFFECT OF TECTONIC STRUCTURE ON THE OCCURRENCE OF GROUND WATER IN THE BASALT OF THE COLUMBIA RIVER GROUP OF THE DALLES AREA, OREGON AND WASHINGTON, W69-10107	02P
RIVERS AND LAKES OF THE MONGOLIAN PEOPLE'S REPUBLIC (RUSSIAN), W69-09941	02E	SOME FEATURES OF SALINE LAKES IN CENTRAL WASHINGTON, W69-10165	02H
ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS, W69-10117	02K	ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON, W69-10169	05C
NATURAL RADIODELEMENTS IN SURFACE AND UNDERGROUND WATERS, W69-10118	02K	CHANGES IN THE OXYGEN DEFICIT OF LAKE WASHINGTON, W69-10182	05C
WASTE DISPOSAL MONTE CARLO SIMULATION OF WASTE DISCHARGE,			

W69-09880	05B	DEPARTMENT OF NATURAL RESOURCES.	
GEOLOGY FOR PLANNING IN MCHENRY COUNTY, W69-09912	06B	W69-10228	06E
EFFECT OF DYE ON SOLAR EVAPORATION OF BRINE, W69-09923	02D	GROUND WATER CONSERVATION.	
WATER POLLUTION AND WASTE CONTROL IN THE TEXTILE INDUSTRY, W69-10257	05D	W69-10298	04B
WASTE TREATMENT		WATER CONTROL	
OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN, W69-10021	05G	WATER SUPPLY, DRAINAGE AND FLOOD CONTROL.	
OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS, W69-10024	05B	W69-10057	06E
PURIFICATION OF INDUSTRIAL WASTES (IN GERMAN), W69-10264	05D	WATER CONVEYANCE	
WASTE WATER MANAGEMENT		PUBLIC WATERSHED ASSOCIATIONS.	
ENVIRONMENTAL CONTROL FOR WATER RESOURCES IN OTTAWA COUNTY PREFEASIBILITY REPORT.	05D	W69-10028	04D
W69-10205		W69-10029	04D
WASTE WATER TREAT		W69-10030	04D
TEXTILE INDUSTRY WARS ON STREAM WASTE POLLUTION, W69-10277	05G	W69-10031	04D
WASTE WATER TREATMENT		WATER DEMAND	
SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM, W69-10128	05D	WATER REUSE A TEXAS NECESSITY.	
W69-10128		W69-09882	05D
WATER POLLUTION AND WASTE CONTROL IN THE TEXTILE INDUSTRY, W69-10257	05D	FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER.	
A REVIEW OF THE LITERATURE OF 1964 ON WASTE WATER AND WATER POLLUTION CONTROL.		W69-10004	03B
W69-10271	05D	RESEARCH ON NATURAL RESOURCES A REVIEW AND COMMENTARY.	
A REVIEW OF THE LITERATURE OF 1963 ON WASTE WATER AND WATER POLLUTION CONTROL.		W69-10210	06D
W69-10272	05D	WATER DISTRIBUTION(APPLIED)	
CHEMICAL PURIFICATION OF VARIOUS INDUSTRIAL WASTE WATERS (IN GERMAN), W69-10280	05D	MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER.	
WASTES TREATMENT PLANT FOR COTTON FINISHING INDUSTRY, SAYLESVILLE RHODE ISLAND.		W69-09918	06A
W69-10290	05D	REGIONAL WATER DISTRIBUTION DISTRICT ACT.	
WASTE WATER(POLLUTION)		W69-10234	04A
ENVIRONMENTAL CONTROL FOR WATER RESOURCES IN OTTAWA COUNTY PREFEASIBILITY REPORT.		WATER DISTRICTS	
W69-10205	05D	WATER SERVICE DISTRICT.	
WATER		W69-10049	06E
EXCESSIVE WATER FERTILIZATION.		REGIONAL WATER DISTRIBUTION DISTRICT ACT.	
W69-10178	05C	W69-10234	04A
WATER ALLOCATION(POLICY)		WATER EQUIVALENT	
MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER.		INVESTIGATION OF A METHOD OF MEASURING SNOW STORAGE BY USING THE GAMMA RADIATION OF THE EARTH.	
W69-09918	06A	W69-10142	02C
WATER RIGHTS LAW IN IOWA,		WATER FRONT	
W69-10216	06C	POWER TO ACQUIRE AND DISPOSE OF PROPERTY RESTRICTIONS AS TO DISPOSITION OF WATER FRONT.	
W69-10216		W69-09889	06E
WATER BALANCE		WATER LAW	
GROUND WATER SHARE OF THE WATER BALANCE AND AN EXAMPLE OF A RIVER CATCHMENT IN THE SEASIDE REGION (POLISH),		CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS.	
W69-10104	02A	W69-09979	06E
DEVELOPED EQUATION OF THE WATER BALANCE (POLISH),		GROUNDWATER LEGISLATION.	
W69-10108	02A	W69-09981	06E
THE PROBLEM OF THORNTHWAITE AND MATHER'S METHOD OF WATER BALANCE IN ITS APPLICATION TO POLAND (POLISH),		WATER LEVELS	
W69-10127	02A	BROWN V ELLINGSON (WITHDRAWAL OF LAKE WATER).	
WATER CHEMISTRY		W69-10059	06E
CHEMISTRY OF N AND NH IN COX HOLLOW LAKE,		GROUND-WATER LEVELS IN IDAHO, 1969,	
W69-09881	05A	W69-10081	02F
OBSERVATIONS OF GASES IN CRESAPEAKE BAY SEDIMENTS,		WATER-LEVEL CHANGES 1964-1968, NORTHERN HIGH PLAINS OF COLORADO,	
W69-09900	02K	W69-10094	02F
URANIUM DISEQUILIBRIUM IN GROUNDWATER AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS,		SURFACE-WATER DISCHARGE AND GROUND-WATER LEVELS IN THE EAST FORK RIVER AREA, SUBLLETTE COUNTY, WYOMING.	
W69-09925	02K	W69-10097	02E
OXYGENATION OF IRON(II) IN CONTINUOUS REACTORS,		WATER MANAGEMENT	
W69-10293	05D	IMPROVEMENT DISTRICTS OF RIVER WATER - DRAINAGE AND LEVEE DISTRICTS.	
WATER CIRCULATION		W69-10066	06E
UNSTEADY CIRCULATION IN SHALLOW LAKES,		WATER MANAGEMENT(APPLIED)	
W69-09886	02H	IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL.	
WATER CONSERVATION		W69-09936	06A
DEPARTMENT OF WATER RESOURCES.		PUBLIC WATERSHED ASSOCIATIONS.	
W69-10032	06E	W69-10028	04D
WATER RIGHTS AND ADMINISTRATION WITH RESPECT TO SOIL AND WATER CONSERVATION.		W69-10029	04D
W69-10221	06E	W69-10030	04D
		W69-10031	04D
		WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN THE DISTRICT OF COLUMBIA.	
		W69-10102	04A
		WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN MARYLAND.	
		W69-10103	04A
		WATER RIGHTS POLICIES IN THE SOUTHEAST,	
		W69-10220	06B
		ARKANSAS WATERWAYS COMMISSION.	
		W69-10236	04A

WATER POLICY DEPARTMENT OF WATER RESOURCES. W69-10032	06E	NATURE OF TURBIDITY IN THE ILLINOIS RIVER, W69-09885 02J
WATER RIGHTS POLICIES IN THE SOUTHEAST, W69-10220	06B	PROCESSING OF DIGITAL DATA LOGGER STD TAPES AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AND THE BUREAU OF COMMERCIAL FISHERIES, LA JOLLA, CALIFORNIA, W69-09894 07C
WATER POLLUTION A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-09954	06E	WATER QUALITY OF MOUNTAIN WATERSHEDS, W69-09943 05B
COMMENT ON ECONOMY OF WATER QUALITY MANAGEMENT AND POLLUTION CONTROL, W69-09965	05G.	WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN, W69-09947 05G
THE FRESH WATER OF NEW YORK STATE ITS CONSERVATION AND USE. W69-09969	06B	A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-09954 06E
WATER POLLUTION AND DISPOSAL OF WASTES. W69-10035	05B	THE RANGE OF CHOICE IN WATER MANAGEMENT, W69-09964 05G
POLLUTION OF STREAMS. W69-10071	05G	WATER QUALITY CRITERIA. W69-09967 05G
PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE, W69-10139	05C	WATER QUALITY CONTROL OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN, W69-10021 05G
GROUND WATER CONSERVATION. W69-10298	04B	OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS, W69-10024 05B
SANITARY PROVISIONS. W69-10300	05F	SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM, W69-10128 05D
WATER POLLUTION CONTROL MONTE CARLO SIMULATION OF WASTE DISCHARGE, W69-09880	05B	OXYGENATION OF IRON(II) IN CONTINUOUS REACTORS, W69-10293 05D
WATER POLLUTION AND DISPOSAL OF WASTES. W69-10037	05B	WATER QUALITY CRITERIA WATER QUALITY CRITERIA. W69-09967 05G
ON CONTROL OF LAKE EUTROPHICATION EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS--(IN GERMAN), W69-10164	05C	WATER RECREATIONAL AREAS WATER RECREATIONAL AREAS. W69-10055 06E
TRENDS IN METROPOLITAN WATER DEVELOPMENT, W69-10195	06B	WATER REPELLENT SOILS SOIL WETTABILITY A NEGLECTED FACTOR IN WATERSHED MANAGEMENT, W69-09991 02G
REUTER V DEPT OF NATURAL RESOURCES (ADMINISTRATIVE FINDING OF EFFECTS UPON WATER POLLUTION AS PREREQUISITE TO ISSUANCE OF DREDGING PERMITS). W69-10242	05G	WATER RESOURCE ADMINISTRATION NEW HORIZONS IN WATER RESOURCES ADMINISTRATION, W69-09977 06B
WATER SUPPLY. W69-10246	05G	WATER RESOURCE DEVELOPMENT COMPARISONS IN RESOURCE MANAGEMENT, W69-09952 06B
TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT. W69-10296	05G	ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT, W69-09973 06B
WATER POLLUTION EFFECTS EPIDEMIC GIAUDIASIS AT A SKI RESORT, W69-10079	05C	NEW HORIZONS IN WATER RESOURCES ADMINISTRATION, W69-09977 06B
PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE, W69-10139	05C	STATE GOVERNMENT A FORCE IN WATER DEVELOPMENT, W69-10193 06E
SURFACE-ACTIVE AGENTS IN TEXTILE PROCESSES AND THEIR EFFECT ON EFFLUENTS, W69-10260	05D	MEETING STATE RESPONSIBILITY IN WATER RESOURCES DEVELOPMENT, W69-10194 06B
WATER POLLUTION SOURCES WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN, W69-09947	05G	WATER POLICY THEMES AND PROBLEMS FOR THE 1960'S AND 1970'S SUMMARY AND CONTENT, W69-10200 06B
AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH), W69-10088	05D	WATER RESOURCES GROUNDWATER IN OGALLALA FORMATION IN THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO, W69-09913 02F
DEPOSIT OF SAWMILL WASTE IN WATERS. W69-10222	05G	GROUND-WATER RESOURCES OF ESSEX COUNTY, NEW JERSEY, W69-09933 02F
WATER POLLUTION TREATMENT AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH), W69-10088	05D	THE AVAILABILITY OF GROUNDWATER FROM THE POTOMAC FORMATION IN THE CHESAPEAKE AND DELAWARE CANAL AREA, DELAWARE, W69-09942 02F
CHEMICAL TREATMENT OF OIL SLICKS, A STATUS REPORT ON THE USE OF CHEMICALS AND OTHER MATERIALS TO TREAT OIL SPILLED ON WATER. W69-10252	05D	GROUNDWATER RESOURCES OF PAMPANGA PROVINCE, W69-09948 02F
WATER PRESSURE ARTPSIAN WELLS. W69-10067	06E	THE FRESH WATER OF NEW YORK STATE ITS CONSERVATION AND USE. W69-09969 06B
WATER PROJECT PLANNING ACTIVITY ANALYSIS IN WATER PLANNING, W69-09982	06B	ACTIVITY ANALYSIS IN WATER PLANNING, W69-09982 06B
WATER PROPERTIES MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH), W69-09904	07B	ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES. W69-09983 06B
WATER PURIFICATION VERSATILE ION EXCHANGE RESINS CAN SOLVE POLLUTION PROBLEMS. W69-10263	05D	LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK METROPOLITAN REGION, W69-10023 06A
WATER QUALITY		WATER RESOURCES OF THE JOPLIN AREA, MISSOURI, W69-10095 02F
		HYDROLOGY OF A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,

		SUBJECT INDEX	WAT-WAT
W69-10110	02E	W69-10197	05D
WATER-BEARING CHARACTERISTICS AND OCCURRENCE OF AQUIFERS IN MARTIN COUNTY, NORTH CAROLINA, W69-10144		RESEARCH AND DEVELOPMENT FOR REUSE OF WATER, W69-10198	05D
HYDROGEOLOGY OF THE UPPER CAPIBARIBE BASIN PERNAMBUCO, BRAZIL A RECONNAISSANCE IN AN AREA OF CRYSTALLINE ROCKS, W69-10145		WATER RIGHTS CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS, W69-09979	06E
TRENDS IN WATER RIGHTS LEGISLATION. W69-10217		CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS, W69-09980	06B
WATER IN TEXTILE PROCESSING, W69-10278		GROUNDWATER LEGISLATION, W69-09981	06E
WATER RESOURCES DEVELOPMENT ARKANSAS WATER RESOURCES SUPPLY, USE, AND RESEARCH NEEDS, W69-09940		WATER RIGHTS LAW IN IOWA, W69-10216	06C
A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-09954		TRENDS IN WATER RIGHTS LEGISLATION. W69-10217	06B
CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS, W69-09980		WATER RIGHTS POLICIES IN THE SOUTHEAST, W69-10220	06B
TENNESSEE TOMBIGBEE WATERWAY DEVELOPMENT COMPACT. W69-10010		WATER RIGHTS AND ADMINISTRATION WITH RESPECT TO SOIL AND WATER CONSERVATION, W69-10221	06E
INTERREGIONAL INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10013		WATER SOURCES TESTING OF WATER SUPPLIES, W69-10040	06E
WATER RECREATIONAL AREAS. W69-10055		WATER STORAGE SEMPOR PROJECT-GENERAL PLAN, W69-10100	08A
INTERSTATE WATERSHED COOPERATION ACT. W69-10070		ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS, W69-10130	02G
WATER RESOURCES RESEARCH INTERESTS IN THE SENIOR COLLEGES AND UNIVERSITIES OF NORTH CAROLINA. W69-10083		WATER STRUCTURE SEMPOR PROJECT-GENERAL PLAN, W69-10100	08A
INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA. W69-10084		WATER SUPPLY GEOLOGY FOR PLANNING IN MCHEBRY COUNTY, W69-09912	06B
ECONOMIC EVALUATION OF WATER PART 6, A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY, W69-10087		FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER, W69-10004	03B
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN THE DISTRICT OF COLUMBIA. W69-10102		DYNAMICS OF OBJECTS IRRIGATORY SYSTEMS REGULATION, W69-10025	03F
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN MARYLAND. W69-10103		FUTURE SUPPLIES OF WATER FOR DOMESTIC USE, W69-10039	06E
WATER RESOURCES RESEARCH CATALOG, VOLUME FOUR. W69-10115		SEMPOR PROJECT-GENERAL PLAN, W69-10100	08A
TRENDS IN METROPOLITAN WATER DEVELOPMENT, W69-10195		WATER SUPPLY. W69-10246	05G
RESEARCH ON NATURAL RESOURCES A REVIEW AND COMMENTARY, W69-10210		LOCATING SOURCE OF WATER SUPPLY OUTSIDE OF MUNICIPALITIES. W69-10251	04A
THE INTERSTATE COMPACT--A FORM OF CREATIVE FEDERALISM, W69-10214		BIOLOGICAL TREATMENT OF TEXTILE EFFLUENTS, W69-10261	05D
CONNECTICUT RIVER FLOOD CONTROL COMPACT. W69-10224		WATER TEMPERATURE DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE, W69-10140	07B
WHITE RIVER NAVIGATION DISTRICT COMMISSION. W69-10235		WATER TRANSFER LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK METROPOLITAN REGION, W69-10023	06A
WINNIA BAY TO SOUTH, ASHLEY RIVER AND SHIPYARD RIVER. W69-10238		THE ECONOMICS OF WATER TRANSFER, W69-10208	06B
SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE, W69-10292		WATER TREATMENT OXYGENATION OF IRON(II) IN CONTINUOUS REACTORS, W69-10293	05D
WATER RESOURCES ECONOMICS ECONOMIC EVALUATION OF WATER PART 6, A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY, W69-10087		WATER TYPES AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-10187	03F
WATER RESOURCES RESEARCH WATER RESOURCES RESEARCH INTERESTS IN THE SENIOR COLLEGES AND UNIVERSITIES OF NORTH CAROLINA. W69-10083		WATER UTILIZATION WATER USE IN THE PETROLEUM AND NATURAL GAS INDUSTRIES, W69-09944	06D
INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA. W69-10084		WATER RECREATION - PUBLIC USE OF 'PRIVATE' WATERS, W69-10215	06B
ANNUAL REPORT, FISCAL YEAR 1969, W69-10295		WATER VALUES UNITED STATES V 930.65 ACRES OF LAND IN JEFFERSON COUNTY (VALUATION OF LAND WITHOUT WATER SUPPLY). W69-10058	06E
WATER RESOURCES RESEARCH CATALOG WATER RESOURCES RESEARCH CATALOG, VOLUME FOUR. W69-10115		WATER WELLS TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA 2, FINITE RESERVOIRS, W69-09926	08E
WATER REUSE WATER REUSE A TEXAS NECESSITY, W69-09882			
WASTE WATER RECLAMATION, LOS ANGELES COUNTY,			

SURFACE-WATER DISCHARGE AND GROUND-WATER LEVELS IN THE EAST FORK RIVER AREA, SUBLLETTE COUNTY, WYOMING, W69-10097	02E	WELL SCREENS EVALUATION AND CONTROL OF CORROSION AND ENCRUSTATION IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN, W69-09910	08G
WATER YIELD THE RECENT 5-YEAR DROUGHT ON SCITUATE WATERSHED AND NEARBY DRAINAGE BASINS IN RHODE ISLAND AND MASSACHUSETTS, W69-10188	02E	WEST GERMANY COMPARISONS IN RESOURCE MANAGEMENT, W69-09952	06B
WATER YIELD IMPROVEMENT FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER, W69-10004	03B	WESTERN RIVERS MUNICIPAL WATER FROM WESTERN RIVERS, W69-09970	06B
FOREST HYDROLOGY RESEARCH IN THE UNITED STATES, W69-10006	09C	WILDLIFE CONSERVATION FISH AND WILDLIFE REGULATIONS. W69-10229	06E
WATERCOURSES(LEGAL) NAVIGABLE WATERCOURSES AS FENCES. W69-10077	06E	WIND VELOCITY RECORDED OBSERVATIONS ON THE INFLUENCE OF CLOUDINESS AND WIND VELOCITY ON THE BRIGHTNESS OF THE DAYLIGHT SKY ABOVE THE WATER SPACE (RUSSIAN), W69-09899	02B
CROSSING OF STREAMS BY RAILROADS. W69-10175	06E	WINTER FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO MOUNTAIN LAKES, W69-10154	02H
WATERSHED MANAGEMENT NEW HORIZONS IN WATER RESOURCES ADMINISTRATION, W69-09977	06B	WISCONSIN WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN, W69-09947	05G
LEACHABILITY OF A WETTING-AGENT TREATMENT FOR WATER-RESISTANT SOILS, W69-09989	02G	REUTER V DEPT OF NATURAL RESOURCES (ADMINISTRATIVE FINDING OF EFFECTS UPON WATER POLLUTION AS PREREQUISITE TO ISSUANCE OF DREDGING PERMITS). W69-10242	05G
SOIL WETTABILITY A NEGLECTED FACTOR IN WATERSHED MANAGEMENT, W69-09991	02G	WITHDRAWAL BROWN V ELLINGSON (WITHDRAWAL OF LAKE WATER). W69-10059	06E
WATERSHED MANAGEMENT EFFECTS ON BASIN DEVELOPMENT, W69-09999	02A	WOOL INVESTIGATIONS INTO THE CENTRIFUGING OF WOOL-SCOURING LIQUORS FOR WOOL-GREASE RECOVERY, W69-10265	05G
HYDROLOGY OF FOREST LANDS AND RANGELANDS, W69-10002	02A	WOOL SCOUR EFFLUENT TREATMENT AND WOOL GREASE RECOVERY. W69-10268	05D
FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER, W69-10004	03B	WATER POLLUTION (IN FRENCH). W69-10270	05D
REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE-LEHIGH EXPERIMENTAL FOREST, W69-10005	02A	EFFLUENT TREATMENT PLANTS INSTALLATION AT SPINNING WORKS IN DEVON. W69-10273	05D
TECHNIQUES IN GRASSLAND WATERSHED RESEARCH, W69-10007	02A	FACTORS AFFECTING RECOVERY OF WAX FROM WOOL SCOURING LIQUORS, W69-10284	05G
PUBLIC WATERSHED ASSOCIATIONS. W69-10028	04D	AERATION RECOVERY OF LANOLIN FROM WOOL SCOUR LIQUORS, W69-10286	05G
W69-10029	04D	WOOL GREASE INVESTIGATIONS INTO THE CENTRIFUGING OF WOOL-SCOURING LIQUORS FOR WOOL-GREASE RECOVERY, W69-10265	05G
W69-10030	04D	TREATMENT OF WOOL SCOUR EFFLUENT AND THE RECOVERY OF WOOL GREASE. W69-10266	05D
W69-10031	04D	WOOL WAX FACTORS AFFECTING RECOVERY OF WAX FROM WOOL SCOURING LIQUORS, W69-10284	05G
INTERSTATE WATERSHED COOPERATION ACT. W69-10070	06B	WYOMING INITIAL PERIODICITY OF NEW GEYSER, YELLOWSTONE NATIONAL PARK, W69-10078	02F
WATERSHED MANAGEMENT FOREST HYDROLOGY RESEARCH IN THE UNITED STATES, W69-10006	09C	YELLOWSTONE NATIONAL PARK INITIAL PERIODICITY OF NEW GEYSER, YELLOWSTONE NATIONAL PARK, W69-10078	02F
WATERSHED PROTECTION FOREST HYDROLOGY RESEARCH IN THE UNITED STATES, W69-10006	09C	TEMPERATURE OPTIMA FOR ALGAL DEVELOPMENT IN YELLOWSTONE AND ICELAND HOT SPRINGS, W69-10160	05C
WATERSHED PROTECTION AND FLOOD PREVENTION ACT ARKANSAS IRRIGATION, DRAINAGE AND WATERSHED IMPROVEMENT DISTRICT ACT OF 1949. W69-10065	06E	2-LEVEL SPILLWAYS METHOD OF DETERMINING THE DISCHARGE OF TWO-LEVEL SPILLWAYS, W69-10129	08B
WEED CONTROL OBSERVATIONS ON EXCESSIVE WEED GROWTH IN TWO LAKES IN NEW ZEALAND, W69-10168	05C		
WELFARE ECONOMICS PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION, W69-09958	06C		
ON THE PURE THEORY OF PUBLIC GOODS, W69-09966	06C		
WELL REGULATIONS ARTESIAN WELLS. W69-10067	06E		

AUTHOR INDEX

ABILDAYEV, A. KH. ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS, W69-10117	02K	BARNHART, E. L. DETERMINATION OF THE DEGRADABILITY OF SYNTHETIC DETERGENTS, W69-10285 05D
ADOLPHSON, DONALD G. HYDROLOGY OF A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA, W69-10110	02E	BAYAZIT, M. RESISTANCE TO REVERSING FLOWS OVER MOBILE BEDS, W69-09892 02E
ALEKIN, YU. M. SHORT-RANGE FORECASTING OF LOWLAND-RIVER RUNOFF, W69-10146	02A	BEAUMONT, R. H. KNIT GOODS FINISHERS AND BIODEGRADABLE DETERGENTS, W69-10267 05D
ALLEN, F. TEXTILE INDUSTRY WARS ON STREAM WASTE POLLUTION, W69-10277	05G	BECHTER, CHARLES S. GEOMETRIC PROGRAMMING NEW OPTIMIZATION TECHNIQUE FOR WATER RESOURCE ANALYSTS, W69-10020 06A
ALLEN, R. C. ARAGONITE-CEMENTED SANDSTONE FROM OUTER CONTINENTAL SHELF OFF DELAWARE BAY SUBMARINE LITHIFICATION MECHANISM YIELDS PRODUCT RESEMBLING BEACHROCK, W69-09908	02L	BENNINGA, H. BIOLOGICAL OXYGEN DEMAND (BOD) OF STARCH AND STARCH DERIVATIVES (IN DUTCH), W69-10269 05D
ANDERSON, C. A. INVESTIGATIONS INTO THE CENTRIFUGING OF WOOL-SCOURING LIQUORS FOR WOOL-GREASE RECOVERY, W69-10265	05G	BENTON, ALLEN H. RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT, W69-10080 05C
FACTORS AFFECTING RECOVERY OF WAX FROM WOOL SCOURING LIQUORS, W69-10284	05G	BENTZ, A. STUDY OF IRRIGATION BY SPRINKLING (FRENCH), W69-09903 03F
AERATION RECOVERY OF LANOLIN FROM WOOL SCOUR LIQUORS, W69-10286	05G	MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH), W69-09904 07B
ANDERSON, GEORGE C. SOME FEATURES OF SALINE LAKES IN CENTRAL WASHINGTON, W69-10165	02H	BERGEN, JAMES D. HEATED THERMOPILE ANEMOMETER COMPARED WITH SENSITIVE CUP ANEMOMETER IN NATURAL AIRFLOW, W69-09985 07B
ANDERSON, G. C. ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON, W69-10169	05C	BERNHARD, P. WATER IN TEXTILE PROCESSING, W69-10278 05G
ASENDORF, ERICH PURIFICATION OF INDUSTRIAL WASTES (IN GERMAN), W69-10264	05D	BERTHOUEX, PAUL M. MONTE CARLO SIMULATION OF WASTE DISCHARGE, W69-09880 05B
ASTAKHOVA, N. I. INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR, W69-09920	02D	BRECHET, EDWARD W. STATE REGULATION OF CHANNEL ENCROACHMENTS, W69-10207 06E
ASYLBAYEV, U. KH. ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS, W69-10117	02K	BIGGS, A. I. BIOLOGICAL TREATMENT OF TEXTILE EFFLUENTS, W69-10261 05D
AUSTIN, R. S. WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER, W69-10136	02D	BLACK, H. H. INDUSTRIAL POLLUTION OF INTERNATIONAL BOUNDARY WATERS ALONG THE NIAGARA FRONTIER, W69-10291 05B
BAIRD, I. E. A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND, W69-10150	02L	BLANC, P. GEOLOGICAL EVOLUTION OF OUED SAOURA (NORTHWESTERN SAHARA) WATERS (FRENCH), W69-10114 02K
BALLNUS, WILLI CHEMICAL PURIFICATION OF VARIOUS INDUSTRIAL WASTE WATERS (IN GERMAN), W69-10280	05D	BLANEY, HARRY F. DETERMINING WATER REQUIREMENTS FOR SETTLING WATER DISPUTES, W69-10211 06D
BAMERJI, S. K. KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS, W69-10258	05D	BLECHARCZYK, STEPHEN S. STRAINER/FILTER TREATMENT OF COMBINED SEWER OVERFLOWS, W69-10254 05D
BARGUR, JONA INTERREGIONAL INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10013	06B	BOETTCHER, ARNOLD J. WATER-LEVEL CHANGES 1964-1968, NORTHERN HIGH PLAINS OF COLORADO, W69-10094 02F
DYNAMIC INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS), W69-10014	06A	BOGREN, G. G. DISPOSAL OF COMBINED TEXTILE FINISHING WASTES AND DOMESTIC SEWAGE, W69-10288 05D
THE INTERREGIONAL DYNAMIC INPUT-OUTPUT PROGRAMMING MODEL, W69-10015	06B	BONIN, JOSEPH M. SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL BORROWING, W69-09976 06A
ECONOMIC EVALUATION OF WATER PART VI A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY, W69-10016	06A	BOOMAN, K. A. BIODEGRADABLE SURFACTANTS FOR THE TEXTILE INDUSTRY, W69-10259 05D
ECONOMIC EVALUATION OF WATER PART 6, A DYNAMIC INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE CALIFORNIA AND WESTERN STATES WATER ECONOMY, W69-10087	06B	BOSCH, F. M. AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH), W69-10088 05D
BARNES, IWAN EVALUATION AND CONTROL OF CORROSION AND ENCROSTATION IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN, W69-09910	08G	BOWMAN, WALLACE D. RESEARCH ON NATURAL RESOURCES A REVIEW AND COMMENTARY, W69-10210 06D
BARNES, W. V. SURFACE-ACTIVE AGENTS IN TEXTILE PROCESSES AND THEIR EFFECT ON EFFLUENTS, W69-10260	05D	BRABEC, DANIEL J. NATURE OF TURBIDITY IN THE ILLINOIS RIVER, W69-09885 02J
BRANNOCK, P. WATER POLLUTION AND WASTE CONTROL IN THE TEXTILE INDUSTRY,		

W69-10257	05D	W69-09901	02L
BREWER, MICHAEL F. WATER POLICY THEMES AND PROBLEMS FOR THE 1960'S AND 1970'S SUMMARY AND CONTENT, W69-10200	06B	CADIGAN, R. A. IRRAY'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE, W69-09909	02F
THE ECONOMICS OF WATER TRANSFER, W69-10208	06B	CALLAHAN, JAMES E. GEOLOGY OF PROPOSED POWERSITES AT DEER LAKE AND KASNYKU LAKE, BARANOF ISLAND, SOUTHEASTERN ALASKA, W69-09911	08E
BREZGUNOV, V. S. ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM, W69-10119	02K	CAMPA, G. ON THE PURE THEORY OF PUBLIC GOODS, W69-09966	06C
BREZONIK, PATRICK L. CHEMISTRY OF N AND MN IN COX HOLLOW LAKE, W69-09881	05A	CAMPBELL, ERNEST H. LEGAL ASPECTS OF CROSS CONNECTION INSPECTIONS, W69-10060	06E
BROCK, M. LOUISE THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHORYLATION, AND MACROMOLECULES IN BENTHIC ALGAL MATS, W69-10151	05C	CAREY, GEORGE W. LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK METROPOLITAN REGION, W69-10023	06A
TEMPERATURE OPTIMA FOR ALGAL DEVELOPMENT IN YELLOWSTONE AND ICELAND HOT SPRINGS, W69-10160	05C	CARLSON, GEORGE H. SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958- SEPT 1967), W69-10093	02E
THE APPLICATION OF MICRO-AUTORADIOGRAPHIC TECHNIQUES TO ECOLOGICAL STUDIES, W69-10163	07B	CASTLE, EMERY ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT, W69-09973	06B
BROCK, THOMAS D. THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHORYLATION, AND MACROMOLECULES IN BENTHIC ALGAL MATS, W69-10151	05C	CASTLE, EMERY N. ACTIVITY ANALYSIS IN WATER PLANNING, W69-09982	06B
THE HABITAT OF LEUCOTHRIX MUCOR, A WIDESPREAD MARINE MICROORGANISM, W69-10161	05C	CAULFIELD, HENRY P., JR. MUNICIPAL WATER IN FEDERAL PROGRAMS, W69-10196	06B
THE APPLICATION OF MICRO-AUTORADIOGRAPHIC TECHNIQUES TO ECOLOGICAL STUDIES, W69-10163	07B	CECIL, L. K. MUNICIPAL WATER FROM WESTERN RIVERS, W69-09970	06B
BROCK, T. D. TEMPERATURE OPTIMA FOR ALGAL DEVELOPMENT IN YELLOWSTONE AND ICELAND HOT SPRINGS, W69-10160	05C	CHARNES, A. STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN, W69-10018	06A
BROUSE, D. D. COPPER SULPHATE AIR SPRAY CURES LAKE ALGAE PROBLEM, W69-10155	05G	CHERDYNTSEV, V. V. ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS, W69-10117	02K
BROWN, J. L. WASTE-TREATMENT EXPERIENCE REPORTED, W69-10281	05D	CHIRKOV, YU. I. ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS, W69-10130	02G
WASTE TREATMENT AT CANNON MILLS, W69-10282	05D	CHRISTIANSEN, RUDOLPH A. ECONOMIC ASPECTS OF PRIVATELY OWNED FISHING ENTERPRISES IN WISCONSIN, W69-10191	06D
BROWN, J. L., JR. BLEACHERY AND DYEHOUSE WASTE STUDIES, W69-10283	05D	CIRIACY-WANTRUP, S. B. CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS, W69-09980	06B
BROWN, LEWIS B. THE DECOMPOSITION OF PETROLEUM PRODUCTS IN OUR NATURAL WATERS, W69-10082	05B	CLARKE, FRANK E. EVALUATION AND CONTROL OF CORROSION AND ENCROSTATION IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN, W69-09910	08G
BROWN, LINFIELD C. MONTE CARLO SIMULATION OF WASTE DISCHARGE, W69-09880	05B	CLARKE, J. W. STREAMFLOW RECORDS FROM THE SAN DIMAS EXPERIMENTAL FOREST, 1939-1959, W69-09990	02E
BUCHANAN, JAMES M. A PUBLIC CHOICE APPROACH TO PUBLIC UTILITY PRICING, W69-09962	06C	CLARKSON, GEOFFREY P. E. SIMULATION OF INDIVIDUAL AND GROUP BEHAVIOR, W69-09950	06A
BUCHANAN, THOMAS J. DISCHARGE MEASUREMENTS AT GAGING STATIONS, W69-10111	07B	COBB, ERNEST D. MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS, W69-09974	05B
BURTON, IAN THE FLOODPLAIN AND THE SEASHORE A COMPARATIVE ANALYSIS OF HAZARD-ZONE OCCUPANCE, W69-10204	06F	CONRAD, G. GEOCHEMICAL EVOLUTION OF OUED SAOURA (NORTHWESTERN SAHARA) WATERS (FRENCH), W69-10114	02K
BUSBY, C. E. WATER RIGHTS AND ADMINISTRATION WITH RESPECT TO SOIL AND WATER CONSERVATION, W69-10221	06E	COOPER, BYRON W. GEOLOGIC CONTROL OF RAINFALL-RUNOFF RELATIONS IN THE PEAK CREEK WATERSHED, PULASKI AND WYTHE COUNTIES, VIRGINIA, W69-10190	02A
BUTCHER, WILLIAM S. MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER, W69-09918	06A	COOPER, ROLLIN B. ECONOMIC ASPECTS OF PRIVATELY OWNED FISHING ENTERPRISES IN WISCONSIN, W69-10191	06D
BUTLER, GODFREY P. MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING BRINES, THE SABKHA, TRUCIAL COAST, ARABIAN GULF, W69-09906	02L	COOPER, W. W. STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN, W69-10018	06A
BUTTERMORE, PAUL H. WATER USE IN THE PETROLEUM AND NATURAL GAS INDUSTRIES, W69-09984	06D	COREY, RICHARD B.	
BUZAS, MARTIN A. FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY,			

EXCESSIVE WATER FERTILIZATION, W69-10178	05C	DUNIN-BARCOVSKY, L. V. IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL, W69-09936	06A
CRIDDLE, WAYNE D. DETERMINING WATER REQUIREMENTS FOR SETTLING WATER DISPUTES, W69-10211	06D	DUPRE, J. BIODEGRADABLE SURFACTANTS FOR THE TEXTILE INDUSTRY, W69-10259	05D
CROWIN, JAMES G. GROUNDWATER IN OGLALA FORMATION IN THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO, W69-09913	02F	DWORSKY, LEONARD B. STATE GOVERNMENT A FORCE IN WATER DEVELOPMENT, W69-10193	06E
CROSS, W. M. EPIDEMIC GIARDIASIS AT A SKI RESORT, W69-10079	05C	EATON, E. D. WATER RESOURCES RESEARCH, W69-10201	06D
CULLEN, E. M. WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER, W69-10136	02D	EDGERTON, A. T. MICROWAVE RADIOMETRIC SENSING OF SOIL MOISTURE CONTENT, W69-09916	07B
CUSTER, STEPHEN W. STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES, W69-09879	05B	EDMONDS, W. T. SOME FEATURES OF SALINE LAKES IN CENTRAL WASHINGTON, W69-10165	02H
DAHL, RAGNAR GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECESSION IN THE MARVIKSKJOMEN DISTRICT, NORWAY, W69-09924	02C	ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON, W69-10169	05C
DALL'AGLIO, MARIO DISTRIBUTION AND CIRCULATION OF THE MAJOR ELEMENTS IN SURFACE WATERS OF ITALY, W69-09922	02K	CHANGES IN THE OXYGEN DEFICIT OF LAKE WASHINGTON, W69-10182	05C
DAVIS, ROBERT K. THE RANGE OF CHOICE IN WATER MANAGEMENT, W69-09964	05G	ELLIS, MICHAEL J. HYDROLOGY OF A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA, W69-10110	02E
DEBANO, L. F. LEACHABILITY OF A WETTING-AGENT TREATMENT FOR WATER- RESISTANT SOILS, W69-09989	02G	EMBREE, WILLIAM N. COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS, W69-10213	07A
SOIL WETTABILITY A NEGLECTED FACTOR IN WATERSHED MANAGEMENT, W69-09991	02G	ENGELUND, FRANK DISPERSION OF FLOATING PARTICLES IN UNIFORM CHANNEL FLOW, W69-09887	02J
DEBSKI, KAZIMIERZ DEVELOPED EQUATION OF THE WATER BALANCE (POLISH), W69-10108	02A	ENGLEBRECHT, R. S. KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS, W69-10258	05D
POTENTIALLY BIGGEST RUNOFF FROM TORRENTIAL RAINFALLS (POLISH), W69-10112	02A	ESSINGTON, EDWARD H. SNOW EVAPORATION REDUCTION MIGRATION OF EVAPORATION SUPPRESSANTS THROUGH SNOW, W69-09993	07B
DEFILIPPI, JOHN A. OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN, W69-10021	05G	EVANSON, DONALD E. SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE, W69-10292	06A
DELFINO, JOSEPH J. CHEMISTRY OF N AND MN IN COX HOLLOW LAKE, W69-09881	05A	EWING, B. B. KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS, W69-10258	05D
DENDAS, J. STUDY OF IRRIGATION BY SPRINKLING (FRENCH), W69-09903	03F	FEDER, G. L. WATER RESOURCES OF THE JOPLIN AREA, MISSOURI, W69-10095	02F
DERVARTANIAN, M. E. PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES, W69-10171	05F	FEDOROV, T. G. COMPARATIVE ESTIMATE OF METHODS OF COMPUTING EVAPORATION FROM BODIES OF WATER, W69-10131	02D
DEVENDORF, E. INDUSTRIAL POLLUTION OF INTERNATIONAL BOUNDARY WATERS ALONG THE NIAGARA FRONTIER, W69-10291	05B	FEDOROV, S. F. DETERMINATION OF THE SEASONAL AND MONTHLY EVAPORATION NORMALS FROM AGRICULTURAL FIELDS FROM OBSERVATIONS AT A NETWORK OF STATIONS, W69-09921	02D
DHRIMES, P. J. ALTERNATIVE ASYMPTOTIC TESTS OF SIGNIFICANCE AND RELATED ASPECTS OF 2SLS AND 3SLS ESTIMATED PARAMETERS, W69-09953	06A	FERINAS, OSCAR J., JR. PERMAFROST AND RELATED ENGINEERING PROBLEMS IN ALASKA, W69-10106	02C
DOBSON, S. SURFACE-ACTIVE AGENTS IN TEXTILE PROCESSES AND THEIR EFFECT ON EFFLUENTS, W69-10260	05D	FIDLER, RICHARD E. HYDROGEOLOGY OF THE SCIOTO RIVER VALLEY NEAR PIKETON, SOUTH- CENTRAL OHIO, W69-10105	02F
DOODY, JAMES J. CONDUCTIVE USE OF GROUND AND SURFACE WATERS, W69-10012	06A	FILHO, L. G. C. HYDROGEOLOGY OF THE UPPER CAPIBARIBE BASIN PERNAMBUCO, BRAZIL A RECONNAISSANCE IN AN AREA OF CRYSTALLINE ROCKS, W69-10145	02F
DORT, WAKEFIELD, JR. INITIAL PERIODICITY OF NEW GEYSER, YELLOWSTONE NATIONAL PARK, W69-10078	02F	FILIN, A. S. ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K
DRACHEV, S. B. PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE BOSKVA RIVER AS AN EXAMPLE, W69-10139	05C	FINDENEGG, INGO TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD, W69-10181	02H
DRACUP, JOHN A. IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS, W69-10019	02F	FIORICA, VINCENT A TABLE FOR CONVERTING PH TO HYDROGEN ION CONCENTRATION (HG) OVER THE RANGE 5-9, W69-10148	02K
DUNFORD, E. G. TECHNIQUES IN GRASSLAND WATERSHED RESEARCH, W69-10007	02A	FISHER, DONALD W. OCCURRENCE OF SULFATE AND NITRATE IN RAINFALL, W69-10153	05B
FISH, G. R.			

OBSEVATIONS ON EXCESSIVE WEED GROWTH IN TWO LAKES IN NEW ZEALAND, W69-10168	05C	W69-09987	07B
FITZGEALD, G. P. PSEUDOMONAS AERUGINOSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES, W69-10171	05F	GRAY, K. E. TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA 2, FINITE RESERVOIRS, W69-09926	08E
FLIRMING, R. D. WATER REUSE A TEXAS NECESSITY, W69-09882	05D	ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION, W69-09927	08E
FOGG, G. E. THE IMPORTANCE OF EXTRACELLULAR PRODUCTS OF ALGAE IN FRESHWATER, W69-10180	05C	GREENE, GORDON W. PERMAFROST AND RELATED ENGINEERING PROBLEMS IN ALASKA, W69-10106	02C
FOX, IRVING K. NEW HORIZONS IN WATER RESOURCES ADMINISTRATION, W69-09977	06B	GUESS, C. P., JR. WATER RIGHTS POLICIES IN THE SOUTHEAST, W69-10220	06B
ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES, W69-09983	06B	GUETZKOW, LOWELL C. SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958- SEPT 1967), W69-10093	02E
FREEMAN, A. MYRICK, III. ADVOCACY AND RESOURCE ALLOCATION DECISIONS IN THE PUBLIC SECTOR, W69-10203	06B	GUILLARD, ROBERT R. L. THE RELATIONSHIP OF THE DISTRIBUTION OF THE DIATOM SKELETONEMA TROPICUM TO TEMPERATURE, W69-10162	05C
FRENKLICH, M. S. THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS, W69-10121	02K	GUNAJI, NARENDRA N. EVAPORATION INVESTIGATIONS AT ELEPHANT BUTTE RESERVOIR IN NEW MEXICO, W69-09934	02D
FRIEDMAN, G. M. ARAGONITE-CEMENTED SANDSTONE FROM OUTER CONTINENTAL SHELF OFF DELAWARE BAY SUBMARINE LITHIFICATION MECHANISM YIELDS PRODUCT RESEMBLING BEACHROCK, W69-09908	02L	GUNAJI, N. N. EFFECT OF DYE ON SOLAR EVAPORATION OF BRINE, W69-09923	02D
FRYER, G. EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY, W69-10149	02H	COMPUTER TECHNOLOGY IN EVAPORATION STUDIES, W69-09930	02D
GABAY, JACK J. RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT, W69-10080	05C	GUPTA, SHIV K. A NOTE ON THE PARTITIONING OF A SINGLE PRODUCT MARKET INTO TERRITORIES OF OUTLETS, W69-09955	06B
GAMBELL, ARLO W. OCCURRENCE OF SULFATE AND NITRATE IN RAINFALL, W69-10153	05B	HABER, DAVID ARIZONA V. CALIFORNIA -- A BRIEF REVIEW, W69-10212	06E
GARRELS, ROBERT H. EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS--2. APPLICATIONS, W69-10092	01B	HACKETT, JAMES B. GEOLOGY FOR PLANNING IN MCHENRY COUNTY, W69-09912	06B
GATES, G. L. IRMA'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE, W69-09909	02F	HAIMES, YACOV Y. IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS, W69-10019	02F
GAUDET, JOSEPH B. WATER RECREATION - PUBLIC USE OF 'PRIVATE' WATERS, W69-10215	06B	HANSEN, HARRY J. DEPOSITIONAL ENVIRONMENTS OF SUBSURFACE POTOMAC GROUP IN MARYLAND, W69-10113	02J
GAVISH, E. ARAGONITE-CEMENTED SANDSTONE FROM OUTER CONTINENTAL SHELF OFF DELAWARE BAY SUBMARINE LITHIFICATION MECHANISM YIELDS PRODUCT RESEMBLING BEACHROCK, W69-09908	02L	HANSEN, KAJ SEDIMENTS FROM DANISH LAKES, W69-10174	02H
GAVRILOV, YE. YA. ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K	HARVEY, E. J. WATER RESOURCES OF THE JOPLIN AREA, MISSOURI, W69-10095	02F
GEBHART, R. VISCOUS DISSIPATION IN EXTERNAL NATURAL CONVECTION FLOWS, W69-10091	01A	HASLER, ARTHUR D. EXCESSIVE WATER FERTILIZATION, W69-10178	05C
GEMMELL, ROBERT S. ECONOMIC EVALUATION OF FLOW AUGMENTATION A SYSTEMS ANALYSIS CASE STUDY, W69-10190	05G	HEILMAN, PAUL E. RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA, W69-10172	02K
GLEASON, M. N. EPIDEMIC GARDIASIS AT A SKI RESORT, W69-10079	05C	CHANGE IN DISTRIBUTION AND AVAILABILITY OF NITROGEN WITH FOREST SUCCESSION ON NORTH SLOPES IN INTERIOR ALASKA, W69-10173	02K
GLOVNA, EARNEST F. INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT, W69-09891	05B	HELGESON, HAROLD C. EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS--2. APPLICATIONS, W69-10092	01B
GLYNN, LOUIS M. SEDIMENT--ITS CONSEQUENCES AND CONTROL, W69-10003	02J	HERBERT, D. J. LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA, W69-10135	04B
GOLDBERG, IRVING EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT, W69-09986	07B	HERFINDAHL, ORRIS C. ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES, W69-09983	06B
MEASURING MOISTURE NEAR SOIL SURFACE. . . MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE,		HERKEBRATH, W. W. WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER, W69-10136	02D
HIRSH, W. Z. TECHNOLOGICAL PROGRESS AND MICROECONOMIC THEORY, W69-09959		HOBBA, ROBERT L. HYDROLOGY OF FOREST LANDS AND RANGELANDS, W69-10002	02A

HOEH, ROGER S. A STUDY OF THE FEASIBILITY OF SOCIAL SCIENCE RESEARCH DESIGNED TO IDENTIFY AND ANALYZE SOCIAL RESPONSES TO PRECIPITATION MANAGEMENT OPERATIONS IN NEW ENGLAND, W69-10192	06B	KADYROV, N. B. ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS, W69-10117	02K
HOEKSTRA, PIETER MOISTURE MOVEMENT TO A FREEZING FRONT, W69-09928	02G	KALININ, A. M. EXPERIMENTAL PALEOHYDROLOGIC INVESTIGATIONS, W69-10141	02E
HOFFMAN, G. J. WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER, W69-10136	02D	KAPOTOV, A. A. INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR, W69-10132	02A
HOGAN, AUSTIN W. INITIAL PERIODICITY OF NEW GEYSER, YELLOWSTONE NATIONAL PARK, W69-10078	02F	KATES, ROBERT W. THE FLOODPLAIN AND THE SEASHORE A COMPARATIVE ANALYSIS OF HAZARD-ZONE OCCUPANCE, W69-10204	06F
HOLSCHER, CLARK E. FOREST HYDROLOGY RESEARCH IN THE UNITED STATES, W69-10006	09C	KAUFMAN, M. I. URANIUM DISEQUILIBRIUM IN GROUNDWATER AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS, W69-09925	02K
HOLTON, PHILIP J., JR. THE RECENT 5-YEAR DROUGHT ON SCITUATE WATERSHED AND NEARBY DRAINAGE BASINS IN RHODE ISLAND AND MASSACHUSETTS, W69-10188	02E	KENNEDY, JOHN F. FRICTION-FACTORS FOR FLAT-BED FLOWS IN SAND CHANNELS, W69-09893	02E
HOPKINS, WALTER S., JR. IMPACTS OF RECREATION ON COMPETITION FOR USE OF WATER, W69-10202	06D	KENNEDY, J. M. MICROWAVE RADIOMETRIC SENSING OF SOIL MOISTURE CONTENT, W69-09916	07B
HOWELLS, DAVID H. ANNUAL REPORT, FISCAL YEAR 1969, W69-10295	09D	KEYES, C. G., JR. EFFECT OF DYE ON SOLAR EVAPORATION OF BRINE, W69-09923	02D
HUDSON, JAMES W. BASIC DATA REPORT NO 3 FOR RESEARCH ON FLOOD FREQUENCY FOR SMALL DRAINAGE AREAS, W69-09895	02E	COMPUTER TECHNOLOGY IN EVAPORATION STUDIES, W69-09930	02D
HULBERT, EDWARD M. THE RELATIONSHIP OF THE DISTRIBUTION OF THE DIATOM SKELETONEMA TROPICUM TO TEMPERATURE, W69-10162	05C	KHAYLOV, K. M. DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER, W69-10125	02K
HUMMEL, DON TRENDS IN METROPOLITAN WATER DEVELOPMENT, W69-10195	06B	KHITAROV, N. I. SILICA IN AQUEOUS SOLUTIONS, W69-10122	01B
HUTCHINS, WELLS A. GROUNDWATER LEGISLATION, W69-09981	06E	KHOMERIKI, I. V. IDENTIFICATION OF SPECTRAL CHARACTERISTICS OF HYDROLOGICAL SERIES BY A MODIFICATION OF THE GRENANDER-ROSSENBLATT METHOD (RUSSIAN), W69-10096	02E
IKIMOVA, T. G. NATURAL RADIODELMENTS IN SURFACE AND UNDERGROUND WATERS, W69-10118	02K	KILMER, R. L. RESERVOIR LOCATION FOR URBAN RECREATION, W69-10022	04C
ISABAYEV, YE. A. ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN MINERALS AND NATURAL WATERS, W69-10117	02K	KING, PAUL H. DISTRIBUTION OF PESTICIDES IN SURFACE WATERS, W69-09884	05B
JARRETT, HENRY COMPARISONS IN RESOURCE MANAGEMENT, W69-09952	06B	KIPPLE, FRANK P. WATER RECORDS OF PUERTO RICO, 1958-63, W69-10134	02E
JAVANDEL, I. USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW PROBLEMS IN AQUIFER SYSTEMS, W69-09937	07C	KLESCHENKO, A. D. ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS, W69-10130	02G
JEFFERY, H. G. WATER RESOURCES OF THE JOPLIN AREA, MISSOURI, W69-10095	02F	KNAPP, JOHN W. PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS, W69-10011	06A
JENG, R. I. PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES, W69-09902	02A	KOJAN, EUGENE MECHANICS AND RATES OF NATURAL SOIL CREEP, W69-09988	07B
JOBES, H. D. WATER REUSE A TEXAS NECESSITY, W69-09882	05D	KONSTANTINOV, A. R. INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR, W69-09920	02D
JOHANSEN, LEIF SOME NOTES ON THE LINDAHL THEORY OF DETERMINATION OF PUBLIC EXPENDITURES, W69-09951	06B	KORENSHTEYN, V. N. ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K
JOHNSON, AARON, JR. ECONOMIC ASPECTS OF PRIVATELY OWNED FISHING ENTERPRISES IN WISCONSIN, W69-10191	06D	KOUNTZ, R. RUPERT ALGAL RESPIRATION IN A EUTROPHIC ENVIRONMENT, W69-10159	05B
JOHNSON, A. I. SUMMARY OF HYDROLOGIC AND PHYSICAL PROPERTIES OF ROCK AND SOIL MATERIALS, AS ANALYZED BY THE HYDROLOGIC LABORATORY OF THE U.S. GEOLOGICAL SURVEY, 1948-60, W69-10143	02J	KRAMMES, JAY S. SOIL WETTABILITY A NEGLECTED FACTOR IN WATERSHED MANAGEMENT, W69-09991	02G
JONES, JAMES H. PROCESSING OF DIGITAL DATA LOGGER STD TAPES AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AND THE BUREAU OF COMMERCIAL FISHERIES, LA JOLLA, CALIFORNIA, W69-09894	07C	KRAMMES, J. S. LEACHABILITY OF A WETTING-AGENT TREATMENT FOR WATER- RESISTANT SOILS, W69-09989	02G
KACHADOURIAN, REUBEN PERMAFROST AND RELATED ENGINEERING PROBLEMS IN ALASKA, W69-10106	02C	STREAMFLOW RECORDS FROM THE SAN DIMAS EXPERIMENTAL FOREST, 1939-1959, W69-09990	02E
KRAYNOV, S. R. ASPECTS OF THE OCCURRENCE AND MIGRATION OF NIOBIVUM, BERYLLOUM, AND BARE EARTHS IN NATURAL ALKALINE WATERS,			

W69-10116	02K	MODIFICATIONS AND EVALUATING OF THE EVAPOTRANSPIRATION TENT, W69-09984
KRUTCHKOFF, RICHARD G. STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES, W69-09879	05B	02D
KRYUTCHKOVA, N. M. QUANTITATIVE RELATIONS OF THE FEEDING AND GROWTH OF DAPHNIA PULPIS OBUTSA (KUR2) SCOURFIELD, W69-10152	05C	07B
KUNKLE, SAMUEL H. WATER QUALITY OF MOUNTAIN WATERSHEDS, W69-09943	05B	01B
KUZNETSOV, V. I. COMPARATIVE ESTIMATE OF METHODS OF COMPUTING EVAPORATION FROM BODIES OF WATER, W69-10131	02D	06B
KUZNETSOV, YU. V. THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS, W69-10121	02K	02F
KUZ'MIN, P. P. INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR, W69-09920	02D	02E
DETERMINATION OF THE SEASONAL AND MONTHLY EVAPORATION NORMALS FROM AGRICULTURAL FIELDS FROM OBSERVATIONS AT A NETWORK OF STATIONS, W69-09921	02D	03P
LAT, CHINTU NUMERICAL SIMULATION OF WAVE-CREST MOVEMENT IN RIVERS AND ESTUARIES, W69-09919	02E	02J
LARSON, LEE W. COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS, W69-10213	07A	08B
LASTHAN, E. S. BIODEGRADABLE SURFACTANTS FOR THE TEXTILE INDUSTRY, W69-10259	05D	02F
LAWLESS, ROBERT W. GEOMETRIC PROGRAMMING NEW OPTIMIZATION TECHNIQUE FOR WATER RESOURCE ANALYSTS, W69-10020	06A	02F
LEE, G. FRED CHEMISTRY OF N AND MN IN COX HOLLOW LAKE, W69-09881	05A	02F
EXCESSIVE WATER FERTILIZATION, W69-10178	05C	02F
LEE, KEENAN INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS, W69-09932	07B	05C
LEMON, PAUL C. RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT, W69-10080	05C	05C
LENT, J. D. STREAMFLOW RECORDS FROM THE SAN DIMAS EXPERIMENTAL FOREST, 1939-1959, W69-09990	02E	06E
LEWANDOWSKI, ANDRZEJ INVESTIGATION OF WATER RESRVOIR BOTTOM DENSITY USING RADIONETRIC METHODS (POLISH), W69-10109	02J	02F
LIGGETT, J. A. UNSTEADY CIRCULATION IN SHALLOW LAKES, W69-09886	02H	02F
LINDBOM, CHARLES E. ECONOMICS AND THE ADMINISTRATION OF NATIONAL PLANNING, W69-09978	06B	02F
LISITSYN, A. P. THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS, W69-10121	02K	02A
LIU, CHIN S. METEROLOGICAL AND HYDROLOGICAL DROUGHT IN RARITAN RIVER BASIN IN NEW JERSEY, W69-10184	02A	05C
LONNQUIST, C. G. COMPARISON BETWEEN ANALOG AND DIGITAL SIMULATION TECHNIQUES FOR AQUIFER EVALUATION, W69-09931	07C	02A
LOVERA, F. FRICTION-FACTORS FOR FLAT-BED FLOWS IN SAND CHANNELS, W69-09893	02E	02A
LYON, R. J. P. INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS, W69-09932	07B	05C
MACE, ARNETT C., JR.		02A
MEIER, WILBUR L.		02B
MCGREGOR, DON L. SELF-ABSORPTION OF C-14 RADIATION IN FRESHWATER OSTRACODS, W69-10166	02H	02B
MCGUIRE, D. EPIDEMIC GIARDIASIS AT A SKI RESORT, W69-10079	05C	02B
MCNAMARA, E. F. REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE- LEHIGH EXPERIMENTAL FOREST, W69-10005	02A	02A
MCQUILKIN, W. E. REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE- LEHIGH EXPERIMENTAL FOREST, W69-10005	02A	02A
MREGARD, ROBERT O. ALGAE AND PHOSPHORUS IN LAKE MINNETONKA, W69-10167	05C	02A

GEOMETRIC PROGRAMMING	NEW OPTIMIZATION TECHNIQUE FOR WATER RESOURCE ANALYSTS,	06A	NEMHAUSER, G. L.	DISCRETE DYNAMIC PROGRAMMING AND CAPITAL ALLOCATION,	06C
W69-10020			W69-10017		
SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE,	06A		NEUFELD, RONALD D.	REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA,	
W69-10292			W69-10176		05G
MEIMAN, JAMES B.	WATER QUALITY OF MOUNTAIN WATERSHEDS,	05B	NEUMAN, S. P.	USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW PROBLEMS IN AQUIFER SYSTEMS,	07C
W69-09943			W69-09937		
MEKHTIYEVA, V. L.	ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES,	02K	NEWCOMB, R. C.	EFFECT OF TECTONIC STRUCTURE ON THE OCCURRENCE OF GROUND WATER IN THE BASALT OF THE COLUMBIA RIVER GROUP OF THE DALLES AREA, OREGON AND WASHINGTON,	02F
W69-10133			W69-10107		
MELENT'YEV, V. V.	DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE,	07B	NEWHALL, GEORGE H.	WATERSHED MANAGEMENT EFFECTS ON BASIN DEVELOPMENT,	02A
W69-10140			W69-09999		
METREBELI, T. I.	DETERMINATION OF DYNAMIC PRESSURE OF WATER ON A DAM USING THE ERDA METHOD AND TAKING INTO CONSIDERATION THE DAM ELASTICITY (RUSSIAN),	08B	NICHOLS, WILLIAM D.	GROUND-WATER RESOURCES OF ESSEX COUNTY, NEW JERSEY,	02F
W69-10099			W69-09933		
MEYER, JOHN R.	REGIONAL ECONOMICS A SURVEY,	06B	NIEHAUS, R. J.	STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN,	06A
W69-09975			W69-10018		
MICHIELS, L.	AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH),	05D	NORRIS, STANLEY E.	HYDROGEOLOGY OF THE SCIOTO RIVER VALLEY NEAR PIKETON, SOUTH-CENTRAL OHIO,	02F
W69-10088			W69-10105		
MILLER, DAVID H.	TRANSPORT OF INTERCEPTED SNOW FROM TREES DURING SNOW STORMS,	02C	OGDEN, RONALD D.	EFFECTS OF SURFACE MINING ON THE FISH AND WILDLIFE RESOURCES OF THE UNITED STATES,	05C
W69-09998			W69-10137		
MILLER, JAMES P.	SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,	05D	OLSEN, EDGAR O.	A NORMATIVE THEORY OF TRANSFERS,	06B
W69-10128			W69-09960		
MILLER, W. L.	RESERVOIR LOCATION FOR URBAN RECREATION,	04C	ORCUTT, GUY H.	SIMULATION OF ECONOMIC SYSTEMS,	06A
W69-10022			W69-09949		
MILTON, JOHN	RESEARCH ON NATURAL RESOURCES A REVIEW AND COMMENTARY,	06D	ORCUTT, RICHARD G.	AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER,	03F
W69-10210			W69-10187		
MOLLENDORF, J.	VISCOS DISSIPATION IN EXTERNAL NATURAL CONVECTION FLOWS,	01A	ORDWAY, SAMUEL H., JR.	RESEARCH ON NATURAL RESOURCES A REVIEW AND COMMENTARY,	06D
W69-10091			W69-10210		
MOLLOHAN, C. S.	EPIDEMIC GIARDIASIS AT A SKI RESORT,	05C	ORLOVA, A. V.	NATURAL RADIODEMENTS IN SURFACE AND UNDERGROUND WATERS,	02K
W69-10079			W69-10118		
MONIE, W. D.	ALGAE CONTROL WITH COPPER SULFATE,	05G	OSMOND, J. K.	URANIUM DISSEQUILIBRIUM IN GROUNDWATER AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS,	02K
W69-10157			W69-09925		
MOORE, G. T.	EPIDEMIC GIARDIASIS AT A SKI RESORT,	05C	OWENS, MICHAEL	A GAMMA-TRANSMISSION GAGE FOR PROFILING SNOWPACK,	07B
W69-10079			W69-10000		
MOROZOVA, N. G.	NATURAL RADIODEMENTS IN SURFACE AND UNDERGROUND WATERS,	02K	OWENS, MICHAEL S.	PORTABLE RADIOACTIVE ISOTOPE SNOW GAGES FOR PROFILING SNOWPACKS,	07B
W69-10118			W69-09997		
MORRISON, DONALD G.	ON THE INTERPRETATION OF DISCRIMINANT ANALYSIS,	06A	MEASUREMENT OF SNOWPACK PROFILES WITH RADIOACTIVE ISOTOPES,	07B	
W69-09957			W69-10001		
MORRIS, D. A.	SUMMARY OF HYDROLOGIC AND PHYSICAL PROPERTIES OF ROCK AND SOIL MATERIALS, AS ANALYZED BY THE HYDROLOGIC LABORATORY OF THE U.S. GEOLOGICAL SURVEY, 1948-60,	02J	O'CONNELL, D. J.	SURFACE-WATER DISCHARGE AND GROUND-WATER LEVELS IN THE EAST FORK RIVER AREA, SUBLLETTE COUNTY, WYOMING,	02E
W69-10143			W69-10097		
MORTIER, F.	USE OF A MATHEMATICAL MODEL IN THE HYDROLOGIC STUDY AS APPLIED TO THE VEGA DE GRENADE OF SPAIN (FRENCH),	02F	O'MELIA, CHARLES R.	OXYGENATION OF IRON(II) IN CONTINUOUS REACTORS,	05D
W69-10147			W69-10293		
MOSSIN, JAN	TAXATION AND RISK-TAKING AN EXPECTED UTILITY APPROACH,	06B	PANKINA, R. G.	ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES,	02K
W69-09963			W69-10133		
MUNDORFF, JAMES C.	SEDIMENTATION IN BROWNELL CREEK SUBWATERSHED NO. 1,	04D	PARKHURST, JOHN D.	WASTE WATER RECLAMATION, LOS ANGELES COUNTY,	05D
NEBRASKA,			W69-10197		
W69-09946			PENNAK, ROBERT W.	FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO MOUNTAIN LAKES,	02B
MYERS, G. H.	ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION,	08E	W69-10154		
W69-09927			PERLOFF, HARVEY S.	A FRAMEWORK FOR DEALING WITH THE URBAN ENVIRONMENT INTRODUCTORY STATEMENT,	06B
NALEVAJKO, C.	EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO,	05C	W69-10206		
W69-10158			PERRINE, RICHARD L.		
NEMETS, D.	FLUORINE IN THE REGIONALLY METAMORPHOSED SKARNS OF THE CZECH MASSIF (CZECHOSLOVAKIAN),	02K			
W69-10123					

PER-SKE

AUTHOR INDEX

IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS, W69-10019	02F	W69-10002	02A
PESSOA, M. D. HYDROGEOLOGY OF THE UPPER CAPIBARIBE BASIN PERNAMBUCO, BRAZIL A RECONNAISSANCE IN AN AREA OF CRYSTALLINE ROCKS, W69-10145	02F	RYDELL, B. S. URANIUM DISEQUILIBRIUM IN GROUNDWATER AN ISOTOPIC DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS, W69-09925	02K
PETERSON, DONALD R. ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON, W69-10169	05C	RYLING, ROY W. WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN, W69-09947	05G
PHILLIPPE, JONATHAN T. INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS, W69-10098	02A	RYZHENKO, B. B. SILICA IN AQUEOUS SOLUTIONS, W69-10122	01B
PHILLIPS, JAM C. SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM, W69-10128	05D	SANDERS, J. E. ARAGONITE-CEMENTED SANDSTONE FROM OUTER CONTINENTAL SHELF OFF DELAWARE BAY SUBMARINE LITHIFICATION MECHANISM YIELDS PRODUCT BESEMBLING BEACHROCK, W69-09908	02L
PINE, WILFRED H. IRRIGATION WITH RESTRAINTS ON LAND AND WATER RESOURCES, W69-10189	03F	SAY, M. I. RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT, W69-10080	05C
POLYAKOVA, B. G. METHOD OF DETERMINING THE DISCHARGE OF TWO-LEVEL SPILLWAYS, W69-10129	08B	SCHLAG, ALB DISCHARGE MEASUREMENT IN OPEN CHANNELS BY DILUTION METHODS (FRENCH), W69-09905	07B
POMYTKIN, B. A. DETERMINATION OF THE SEASONAL AND MONTHLY EVAPORATION NORMALS FROM AGRICULTURAL FIELDS FROM OBSERVATIONS AT A NETWORK OF STATIONS, W69-09921	02D	SCHRAUFNAGEL, F. H. EXCESSIVE WATER FERTILIZATION, W69-10178	05C
PRICKETT, T. A. COMPARISON BETWEEN ANALOG AND DIGITAL SIMULATION TECHNIQUES FOR AQUIFER EVALUATION, W69-09931	07C	SETH, M. S. TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA 2, FINITE RESERVOIRS, W69-09926	08E
PROKOPOVICH, M. P. LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA, W69-10135	04B	SEWELL, W. R. DERRICK THE COLUMBIA RIVER TREATY AND PROTOCOL AGREEMENT, W69-10209	06E
QUIMPO, RAFAEL G. SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM, W69-10128	05D	SHAFFER, L. R. CALENDAR - DAY C P M, W69-10009	06A
RABINOVICH, YU. I. DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE, W69-10140	07B	SHCHUKIN, G. G. DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE, W69-10140	07B
RANDALL, CLIFFORD W. DISTRIBUTION OF PESTICIDES IN SURFACE WATERS, W69-09884	05B	SHIH, CHIA SHUN OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN, W69-10021	05G
RAWLINS, S. L. WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER, W69-10136	02D	SHIH, CHIA-SHUN INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT, W69-09891	05B
RAWLS, WALTER J. PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS, W69-10011	06A	SHUL'TS, V. L. RIVERS AND LAKES OF THE MONGOLIAN PEOPLE'S REPUBLIC (RUSSIAN), W69-09941	02E
RAYEVSKII, A. N. RECORDED OBSERVATIONS ON THE INFLUENCE OF CLOUDINESS AND WIND VELOCITY ON THE BRIGHTNESS OF THE DAYLIGHT SKY ABOVE THE WATER SPACE (RUSSIAN), W69-09899	02B	SHUNNEY, EDWARD L. STRAINER/FILTER TREATMENT OF COMBINED SEWER OVERFLOWS, W69-10254	05D
REFURGH, WILLIAM S. OBSERVATIONS OF GASES IN CHESAPEAKE BAY SEDIMENTS, W69-09900	02K	SIMONYAK, Z. N. THORIUM ISOTOPES (TH-230, TH-232) IN THE SURFACE LAYER OF THE INDIAN OCEAN SEDIMENTS, W69-10121	02K
REIGNER, IRVIN C. FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER, W69-10004	03B	SIMON, HERBERT A. SIMULATION OF INDIVIDUAL AND GROUP BEHAVIOR, W69-09950	06A
REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE- LEHIGH EXPERIMENTAL FOREST, W69-10005	02A	SINCLAIR, W. C. HYDROGEOLOGY OF THE UPPER CAPIBARIBE BASIN PERNAMBUCO, BRAZIL A RECONNAISSANCE IN AN AREA OF CRYSTALLINE ROCKS, W69-10145	02F
REVELLE, R. ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION, W69-09972	06A	SINEL'NIKOV, V. YE. PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE MOSKVA RIVER AS AN EXAMPLE, W69-10139	05C
REYNOLDS, G. WILLIAM, JR. INITIAL PERIODICITY OF NEW GEYSER, YELLOWSTONE NATIONAL PARK, W69-10078	02F	SINGH, H. W. STUDIES ON MORPHOGENESIS IN A BLUE-GREEN ALGA. I. EFFECT OF INORGANIC NITROGEN SOURCES ON DEVELOPMENTAL MORPHOLOGY OF ANABAENA DOLIOLUM, W69-10177	05C
RODRIQUEZ-ITURBE, IGNACIO THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES, W69-09938	06A	SINGH, KRISHAN P. HYDROLOGIC DISTRIBUTIONS RESULTING FROM MIXED POPULATIONS AND THEIR COMPUTER SIMULATION, W69-09935	07C
ROELS, R. AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH), W69-10088	05D	SIROHI, AMAR S. IRRIGATION WITH RESTRAINTS ON LAND AND WATER RESOURCES, W69-10189	03F
ROGERS, JERRY B. ECONOMIC EVALUATION OF FLOW AUGMENTATION A SYSTEMS ANALYSIS CASE STUDY, W69-10190	05G	SISCO, H. G. GROUND-WATER LEVELS IN IDAHO, 1969, W69-10081	02F
ROSA, J. MARVIN HYDROLOGY OF FOREST LANDS AND RANGELANDS,		SKELTON, JOHN	

WATER RESOURCES OF THE JOPLIN AREA, MISSOURI, W69-10095	02F	SEDIMENT--ITS CONSEQUENCES AND CONTROL, W69-10003	02J
SLADECEK, V. QUANTITATIVE RELATIONS OF THE FEEDING AND GROWTH OF DAPHNIA PULEX OBTUSA (KUBZ) SCOURFIELD, W69-10152	05C	FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER, W69-10004	03B
SMITH, JAMES L. INSTRUMENTATION FOR SNOW GAGING -- YESTERDAY, TODAY, AND TOMORROW, W69-09992	07B	SUNDSTROM, R. W. THE AVAILABILITY OF GROUNDWATER FROM THE POTOMAC FORMATION IN THE CHESAPEAKE AND DELAWARE CANAL AREA, DELAWARE, W69-09942	02F
SNOW EVAPORATION REDUCTION MIGRATION OF EVAPORATION SUPPRESSANTS THROUGH SNOW, W69-09993	07B	TEERINK, JOHN R. ARTIFICIAL DESTRATIFICATION IN RESERVOIRS OF THE CALIFORNIA STATE WATER PROJECT, W69-09883	05C
GAMMA-TRANSMISSION PROFILING RADIOSOPOTE SNOW DENSITY AND DEPTH GAGE, W69-09994	07B	TENNY, M. K. WATER RIGHTS LAW IN IOWA, W69-10216	06C
ISOTOPE SNOW GAGES FOR DETERMINING HYDROLOGIC CHARACTERISTICS OF SNOWPACKS, W69-09995	07B	TEPLINSKIY, G. I. ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K
ISOTOPES -- A MULTIPURPOSE TOOL FOR FOREST WATERSHED RESEARCH, W69-09996	07B	THODOS, GEORGE REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA, W69-10176	05G
PORTABLE RADIOACTIVE ISOTOPE SNOW GAGES FOR PROFILING SNOWPACKS, W69-09997	07B	THOMANN, ROBERT V. OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS, W69-10024	05B
WATERSHED MANAGEMENT EFFECTS ON BASIN DEVELOPMENT, W69-09999	02A	THOMAS, E. A. ON CONTROL OF LAKE EUTROPHICATION EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS--(IN GERMAN), W69-10164	05C
A GAMMA-TRANSMISSION GAGE FOR PROFILING SNOWPACK, W69-10000	07B	EUTROPHICATION OF LAKES AND RIVERS ITS ORIGIN AND PREVENTION (IN GERMAN), W69-10170	05C
MEASUREMENT OF SNOWPACK PROFILES WITH RADIOACTIVE ISOTOPES, W69-10001	07B	THOMAS, H. A. ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION, W69-09972	06A
SMITH, STEPHEN C. ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT, W69-09973	06B	THOMAS, R. G. USE OF A MATHEMATICAL MODEL IN THE HYDROLOGIC STUDY AS APPLIED TO THE VEGA DE GRENADE OF SPAIN (FRENCH), W69-10147	02F
SNOW, W. B. METEROLOGICAL AND HYDROLOGICAL DROUGHT IN RARITAN RIVER BASIN IN NEW JERSEY, W69-10184	02A	THOMPSON, J. R. MODIFICATIONS AND EVALUATING OF THE EVAPOTRANSPIRATION TENT, W69-09984	02D
SOMERS, WILLIAM P. DISCHARGE MEASUREMENTS AT GAGING STATIONS, W69-10111	07B	TIKHOVNIKOV, V. V. ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS, W69-10120	02K
SOOKY, ATTILA A. LONGITUDINAL DISPERSION IN OPEN CHANNELS, W69-09888	02B	TIMUR, A. VELOCITY OF COMPRESSIVE WAVES IN POROUS MEDIA AT PERMAFROST TEMPERATURES, W69-10138	02C
SOYFER, V. N. ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM, W69-10119	02K	TIRTOTJONDRO, RACHMAT SEMPOR PROJECT-GENERAL PLAN, W69-10100	08A
SPARKS, JARED ARKANSAS WATER RESOURCES SUPPLY, USE, AND RESEARCH NEEDS, W69-09940	06D	TISCHER, ROBERT G. THE DECOMPOSITION OF PETROLEUM PRODUCTS IN OUR NATURAL WATERS, W69-10082	05B
SPAULDING, WILLARD M., JR. EFFECTS OF SURFACE MINING ON THE FISH AND WILDLIFE RESOURCES OF THE UNITED STATES, W69-10137	05C	TRAC, M. Q. USE OF A MATHEMATICAL MODEL IN THE HYDROLOGIC STUDY AS APPLIED TO THE VEGA DE GRENADE OF SPAIN (FRENCH), W69-10147	02F
SPEECE, R. E. KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS, W69-10258	05D	TRELEASE, FRANK J. CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS, W69-09979	06E
SPEVAK, YU. A. ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K	TULLOCK, GORDON PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION, W69-09958	06C
SRIVASTAVA, B. S. STUDIES ON MORPHOGENESIS IN A BLUE-GREEN ALGA. I. EFFECT OF INORGANIC NITROGEN SOURCES ON DEVELOPMENTAL MORPHOLOGY OF ANABAENA DOLIOLUM, W69-10177	05C	TURNER, P. M. ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES, 1967, W69-10126	03B
STANIFORTH, SYDNEY D. ECONOMIC ASPECTS OF PRIVATELY OWNED FISHING ENTERPRISES IN WISCONSIN, W69-10191	06D	ULLMANN, Z. DISCRETE DYNAMIC PROGRAMMING AND CAPITAL ALLOCATION, W69-10017	06C
STAROSOLSKY, O. FLOW MEASURING STRUCTURES IN THE HYDROLOGICAL OBSERVATION NETWORK, W69-09929	02B	VARANOV, V. I. NATURAL RADIODELEMENTS IN SURFACE AND UNDERGROUND WATERS, W69-10118	02K
STEDRY, A. STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN, W69-10018	06A	VERDUIJN, JACOB CHANGES IN WESTERN LAKE ERIE DURING THE PERIOD 1948-1962, W69-10156	02H
STELCZER, K. SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958, W69-09939	08A		
STOREY, HERBERT C. HYDROLOGY OF FOREST LANDS AND RANGELANDS, W69-10002	02A		

VINOGRADOV, V. V.	PORTABLE RADIOACTIVE ISOTOPE SNOW GAGES FOR PROFILING SNOWPACKS,	07B
INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR, W69-09920	W69-09997	
VLASOVA, L. S.	A GAMMA-TRANSMISSION GAGE FOR PROFILING SNOWPACK,	07B
ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM, W69-10119	W69-10000	
VOL'FTSUN, I. B.	MEASUREMENT OF SNOWPACK PROFILES WITH RADIOACTIVE ISOTOPES,	07B
TOTAL RUNOFF TRAVEL TIME DURING THE FORMATION OF MIXED 'SURFACE-SUBSURFACE' RAIN FLOODS IN SMALL WATER COURSES, W69-09915	W69-10001	
VORONOV, A. N.	WILSON, JAMES F., JR.	
ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS, W69-10120	MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS, W69-09914	05B
WAANANEN, A. O.	WILSON, THOMAS	
FLOODS OF JANUARY AND FEBRUARY 1969 IN CENTRAL AND SOUTHERN CALIFORNIA, W69-10089	THE REGIONAL MULTIPLIER--A CRITIQUE, W69-09961	06B
WANEK, ALEXANDER A.	WIRTH, THOMAS L.	
GEOLOGY OF PROPOSED POWERSITES AT DEER LAKE AND KASNYKU LAKE, BARANOF ISLAND, SOUTHEASTERN ALASKA, W69-09911	EXCESSIVE WATER FERTILIZATION, W69-10178	05C
WANG, WUN-CHENG	WITHERSPOON, P. A.	
NATURE OF TURBIDITY IN THE ILLINOIS RIVER, W69-09885	USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW PROBLEMS IN AQUIFER SYSTEMS, W69-09937	07C
WARREN, PIERRE S.	WOJCIECHOWSKI, KRZYSZTOF	
DISTRIBUTION OF PESTICIDES IN SURFACE WATERS, W69-09884	THE PROBLEM OF THORNTHTWAITE AND MATHER'S METHOD OF WATER BALANCE IN ITS APPLICATION TO POLAND (POLISH), W69-10127	02A
WASSON, B. E.	WOOD, G. F.	
FLOODS OF JULY 2, 1968, IN JACKSON, MISSISSIPPI, W69-10101	INVESTIGATIONS INTO THE CENTRIFUGING OF WOOL-SCOURING LIQUORS FOR WOOL-GREASE RECOVERY, W69-10265	05G
WATSON, A. C.	WOOD, J. E., III.	
A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-09954	COMMENT ON ECONOMY OF WATER QUALITY MANAGEMENT AND POLLUTION CONTROL, W69-09965	05G
WATTS, CALVIN T.	WROBEL, BERNARD	
MEETING STATE RESPONSIBILITY IN WATER RESOURCES DEVELOPMENT, W69-10194	GROUND WATER SHARE OF THE WATER BALANCE AND AN EXAMPLE OF A RIVER CATCHMENT IN THE SEASIDE REGION (POLISH), W69-10104	02A
WEINGARTNER, H. MARTIN	WYRICK, GRANVILLE G.	
CAPITAL BUDGETING OF INTERRELATED PROJECTS SURVEY AND SYNTHESIS, W69-09971	WATER-BEARING CHARACTERISTICS AND OCCURRENCE OF AQUIFERS IN MARTIN COUNTY, NORTH CAROLINA, W69-10144	02F
WEISBROD, BURTON A.	YEH, H. R.	
COLLECTIVE-CONSUMPTION SERVICES OF INDIVIDUAL-CONSUMPTION GOODS, W69-09974	DISTRIBUTION OF PESTICIDES IN SURFACE WATERS, W69-09884	05B
WEISS, ARDEN O.	YEVJEVICH, V.	
SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE, W69-10292	PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES, W69-09902	02A
WESTLAKE, D. F.	YOTSUKURA, NOBUHIRO	
THE IMPORTANCE OF EXTRACELLULAR PRODUCTS OF ALGAE IN FRESHWATER, W69-10180	MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS, W69-09914	05B
WEST, ROBERT E.	YOUNG, GEORGE K.	
HYDROLOGY OF A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA, W69-10110	SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE, W69-10292	06A
WETZEL, ROBERT C.	ZECKHAUSER, RICHARD	
SELF-ABSORPTION OF C-14 RADIATION IN FRESHWATER OSTRACODS, W69-10166	RESOURCE ALLOCATION WITH PROBABILISTIC INDIVIDUAL PREFERENCES, W69-09956	06C
WETZEL, R. G.	ZIEHER, ROBERT R.	
A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND, W69-10150	EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT, W69-09986	07B
WHITEHEAD, E. L.	MEASURING MOISTURE NEAR SOIL SURFACE . . . MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE, W69-09987	07B
GROUND-WATER LEVELS IN IDAHO, 1969, W69-10081	ZIMMERMANN, FREDERICK L.	
WIENER, A.	THE INTERSTATE COMPACT--A FORM OF CREATIVE FEDERALISM, W69-10214	06B
PLANNING APPROACHES TO WATER RESOURCES DEVELOPMENT AND UTILIZATION IN ISRAEL, W69-10026	ZOBLER, LEONARD	
WIGGERT, JAMES M.	LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK METROPOLITAN REGION, W69-10023	06A
INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS, W69-10098	ZOTIMOV, M. V.	
WILLEN, DONALD W.	INVESTIGATION OF A METHOD OF MEASURING SNOW STORAGE BY USING THE GAMMA RADIATION OF THE EARTH, W69-10142	02C
GAMMA-TRANSMISSION PROFILING RADIOSOTOPES SNOW DENSITY AND DEPTH GAGE, W69-09994	ZUBENOK, L. I.	
ISOTOPE SNOW GAGES FOR DETERMINING HYDROLOGIC CHARACTERISTICS OF SNOWPACKS, W69-09995	INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR, W69-09920	02D

ORGANIZATIONAL INDEX

AEROJET-GENERAL CORP., EL MONTE, CALIF. SPACE DIV.
MICROWAVE RADIOMETRIC SENSING OF SOIL MOISTURE CONTENT,
W69-09916 07B

AGRICULTURAL RESEARCH SERVICE, RIVERSIDE, CALIF. SALINITY
LAB.
WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO
SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER,
W69-10136 02D

AGRICULTURAL RESEARCH SERVICE, WASHINGTON, D.C. AND FOREST
SERVICE (USDA), WASHINGTON, D.C.
SEDIMENT--ITS CONSEQUENCES AND CONTROL,
W69-10003 02J

AKADEMIYA NAUK KAZAKHSKOI SSR, ALMA-ATA AND AKADEMIYA NAUK
SSSR, MOSCOW. INSTITUT GEOLOGII.
ISOTOPIC COMPOSITION OF URANIUM AND ACTINIUM CONTENT IN
MINERALS AND NATURAL WATERS,
W69-10117 02K

AKADEMIYA NAUK SSSR, MOSCOW. INSTITUT BIOLOGII VNUTRENNYKH
VOD.
PROTECTION OF SMALL RIVERS UNDER INTENSIVE USE, TAKING THE
MOSKVA RIVER AS AN EXAMPLE,
W69-10139 05C

AKADEMIYA NAUK SSSR, MOSCOW. INSTITUT GEOKHIMII I
ANALITICHESKOI KHMII.
NATURAL RADIODEMENTS IN SURFACE AND UNDERGROUND WATERS,
W69-10118 02K

SILICA IN AQUEOUS SOLUTIONS,
W69-10122 01B

AKADEMIYA NAUK URSR. INST. OF BIOLOGY OF THE SOUTHERN SEAS.
DISSOLVED ORGANIC MACROMOLECULES IN SEA WATER,
W69-10125 02K

ALASKA UNIV., COLLEGE.
RELATIONSHIP OF AVAILABILITY OF PHOSPHORUS AND CATIONS TO
FOREST SUCCESSION AND BOG FORMATION IN INTERIOR ALASKA,
W69-10172 02K

CHANGE IN DISTRIBUTION AND AVAILABILITY OF NITROGEN WITH
FOREST SUCCESSION ON NORTH SLOPES IN INTERIOR ALASKA,
W69-10173 02K

ALL-UNION SCIENTIFIC RESEARCH INST. OF HYDROGEOLOGY AND
ENGINEERING GEOLOGY, MOSCOW (USSR).
ASPECTS OF THE OCCURRENCE AND MIGRATION OF NIOBUM,
BERYLLOUM, AND RARE EARTHS IN NATURAL ALKALINE WATERS,
W69-10116 02K

ALL-UNION SCIENTIFIC RESEARCH INST. OF HYDROTECHNICS AND
RECLAMATION (USSR).
IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE
APPLICATION TO WATER RESOURCE PLANNING AND CONTROL,
W69-09936 06A

AMERICAN SOCIETY FOR TESTING AND MATERIALS, PHILADELPHIA,
PA.
WATER QUALITY CRITERIA.
W69-09967 05G

MUNICIPAL WATER FROM WESTERN RIVERS,
W69-09970 06B

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF ECONOMICS.
ARKANSAS WATER RESOURCES SUPPLY, USE, AND RESEARCH NEEDS,
W69-09940 06D

ARMY CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, ILL.
CALENDAR - DAY C P M,
W69-10009 06A.

ARMY TERRESTRIAL SCIENCES CENTER, HANOVER, N.H.
MOISTURE MOVEMENT TO A FREEZING FRONT,
W69-09928 02G

AUBURN UNIV., ALA.
SYSTEMS ANALYSIS, OPERATIONS RESEARCH, AND STATE AND LOCAL
BORROWING,
W69-09976 06A

BAUER ENGINEERING, INC., CHICAGO, ILL.
ENVIRONMENTAL CONTROL FOR WATER RESOURCES IN OTTAWA COUNTY
PREFEASABILITY REPORT.
W69-10205 05D

BELL TELEPHONE LABS., INC., CHESTER, N.J. RENNSLAER
POLYTECHNIC INST., TROY, N.Y. DEPT. OF GEOLOGY AND
COLUMBIA UNIV., DOBBS FERRY, N.Y. HUDSON LABS.
ARAGONITE-CEMENTED SANDSTONE FROM OUTER CONTINENTAL SHELF
OFF DELAWARE BAY SUBMARINE LITHIFICATION MECHANISM YIELDS
PRODUCT RESEMBLING BEACHROCK,
W69-09908 02L

BIOLOGICAL STATION, LUNZ AM SEE (AUSTRIA).
TYPES OF PLANKTIC PRIMARY PRODUCTION IN THE LAKES OF THE
EASTERN ALPS AS FOUND BY THE RADIOACTIVE CARBON METHOD,
W69-10181 02H

BOWDOIN COLL., BRUNSWICK, MAINE.
ADVOCACY AND RESOURCE ALLOCATION DECISIONS IN THE PUBLIC
SECTOR,
W69-10203 06B

BOWLING GREEN STATE UNIV., OHIO.
CHANGES IN WESTERN LAKE ERIE DURING THE PERIOD 1948-1962,
W69-10156 02H

BUREAU OF COMMERCIAL FISHERIES, LA JOLLA, CALIF. FISH-
OCEANOGRAPHIC CENTER.
PROCESSING OF DIGITAL DATA LOGGER STD TAPES AT THE SCRIPPS
INSTITUTION OF OCEANOGRAPHY AND THE BUREAU OF COMMERCIAL
FISHERIES, LA JOLLA, CALIFORNIA,
W69-09894 07C

BUREAU OF MINES, WASHINGTON, D.C. DIV. OF STATISTICS.
WATER USE IN THE PETROLEUM AND NATURAL GAS INDUSTRIES,
W69-09944 06D

BUREAU OF RECLAMATION, DENVER, COLO.
ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES, 1967,
W69-10126 03B

BUREAU OF RECLAMATION, SACRAMENTO, CALIF.
LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA,
W69-10135 04B

BUREAU OF SPORT FISHERIES AND WILDLIFE, WASHINGTON, D.C.
EFFECTS OF SURFACE MINING ON THE FISH AND WILDLIFE RESOURCES
OF THE UNITED STATES,
W69-10137 05C

CALIFORNIA STATE DEPT. OF WATER RESOURCES, LOS ANGELES.
CONJUNCTIVE USE OF GROUND AND SURFACE WATERS,
W69-10012 06A

CALIFORNIA STATE DEPT. OF WATER RESOURCES, SACRAMENTO.
ARTIFICIAL DESTRATIFICATION IN RESERVOIRS OF THE CALIFORNIA
STATE WATER PROJECT,
W69-09883 05C

CALIFORNIA UNIV., BERKELEY.
USE OF THE FINITE ELEMENT METHOD IN SOLVING TRANSIENT FLOW
PROBLEMS IN AQUIFER SYSTEMS,
W69-09937 07C

CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER
RIGHTS,
W69-09980 06B

CALIFORNIA UNIV., BERKELEY. GIANNINI FOUNDATION.
THE ECONOMICS OF WATER TRANSFER,
W69-10208 06B

CALIFORNIA UNIV., BERKELEY. SANITARY ENGINEERING RESEARCH
LAB.
INTERREGIONAL INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS),
W69-10013 06B

DYNAMIC INPUT-OUTPUT ANALYSIS (PROGRAMMING ASPECTS),
W69-10014 06A

THE INTERREGIONAL DYNAMIC INPUT-OUTPUT PROGRAMMING MODEL,
W69-10015 06B

ECONOMIC EVALUATION OF WATER PART VI A DYNAMIC
INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE
CALIFORNIA AND WESTERN STATES WATER ECONOMY,
W69-10016 06A

CALIFORNIA UNIV., BERKELEY. SANITARY ENGINEERING RESEARCH
LAB.
ECONOMIC EVALUATION OF WATER PART 6, A DYNAMIC
INTERREGIONAL INPUT-OUTPUT PROGRAMMING MODEL OF THE
CALIFORNIA AND WESTERN STATES WATER ECONOMY,
W69-10087 06B

CALIFORNIA UNIV., LOS ANGELES.
TECHNOLOGICAL PROGRESS AND MICROECONOMIC THEORY,
W69-09959 06B

A PUBLIC CHOICE APPROACH TO PUBLIC UTILITY PRICING,
W69-09962 06C

IDENTIFICATION OF DISTRIBUTED UNCONFINED AQUIFER PARAMETERS,
W69-10019 02F

CALIFORNIA UNIV., RIVERSIDE.
MODERN EVAPORITE DEPOSITION AND GEOCHEMISTRY OF COEXISTING
BRINES, THE SABRHA, TRUCIAL COAST, ARABIAN GULF,
W69-09906 02L

CENTRE DE RECHERCHES SUR LES ZONES ARIDES, PARIS (FRANCE).
GEOCHEMICAL EVOLUTION OF OUED SAOURA (NORTHWESTERN SAHARA)
WATERS (FRENCH),
W69-10114 02K

CHEVRON RESEARCH CO., LA HABRA, CALIF.
VELOCITY OF COMPRESSIVE WAVES IN POROUS MEDIA AT
PERMAFROST TEMPERATURES,
W69-10138 02C

CHICAGO UNIV., ILL.
POLITICS AND LAND USE THE INDIANA SHORELINE OF LAKE
MICHIGAN,
W69-10199 06E

CIVIL AEROMEDICAL INST., OKLAHOMA CITY, OKLA.
A TABLE FOR CONVERTING PH TO HYDROGEN ION CONCENTRATION (RC)
OVER THE RANGE 5-9.

W69-10148	02K	MEASUREMENT OF WATER PROFILES USING A GAMMA-RAY METHOD (FRENCH), W69-09904	07B
COLORADO STATE UNIV., FORT COLLINS, DEPT. OF CIVIL ENGINEERING.		DEPARTMENT OF WATER TECHNOLOGY, PRAGUE (CZECHOSLOVAKIA). QUANTITATIVE RELATIONS OF THE FEEDING AND GROWTH OF DAPHNIA PULEX OBTUSA (KURZ) SCOURFIELD, W69-10152	05C
THE APPLICATION OF CROSS-SPECTRAL ANALYSIS TO HYDROLOGIC TIME SERIES, W69-09938	06A	ECONOMIC RESEARCH SERVICE, WASHINGTON, D. C. NATURAL RESOURCE ECONOMICS DIV.	
COLORADO STATE UNIV., FORT COLLINS.		ECONOMIC ASPECTS OF PRIVATELY OWNED FISHING ENTERPRISES IN WISCONSIN, W69-10191	06D
WATER QUALITY OF MOUNTAIN WATERSHEDS, W69-09943	05B	ECONOMIC RESEARCH SERVICE, WASHINGTON, D.C. ECONOMICS DIV. GROUNDWATER LEGISLATION, W69-09981	06E
ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT, W69-09973	06B	FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, EDISON, N. J. WATER QUALITY LAB.	
COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.		CHEMICAL TREATMENT OF OIL SLICKS, A STATUS REPORT ON THE USE OF CHEMICALS AND OTHER MATERIALS TO TREAT OIL SPILLED ON WATER. W69-10252	05D
PROPERTIES OF NON-HOMOGENEOUS HYDROLOGIC SERIES, W69-09902	02A	FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, ERIE, PA. AND HAMMERMILL PAPER CO., ERIE, PA.	
COLORADO UNIV., BOULDER.		JOINT MUNICIPAL AND SEMICHEMICAL PULPING WASTE TREATMENT, A PILOT STUDY EVALUATING COMBINED TREATMENT OF DOMESTIC SEWAGE AND WEAK SEMICHEMICAL PULPING AND PAPERMAKING WASTES. W69-10253	05D
STATE GOVERNMENT A FORCE IN WATER DEVELOPMENT, W69-10193	06E	FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, D.C. AND FRAM CORP., PROVIDENCE, R.I.	
MEETING STATE RESPONSIBILITY IN WATER RESOURCES DEVELOPMENT, W69-10194	06B	STRAINER/FILTER TREATMENT OF COMBINED SEWER OVERFLOWS, W69-10254	05D
TRENDS IN METROPOLITAN WATER DEVELOPMENT, W69-10195	06B	FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, D.C.	
MUNICIPAL WATER IN FEDERAL PROGRAMS, W69-10196	06B	IMPROVED SEALANTS FOR INFILTRATION CONTROL, THE DEVELOPMENT AND DEMONSTRATION OF MATERIALS TO REDUCE OR ELIMINATE WATER INFILTRATION INTO SEWAGE. W69-10255	05G
WASTE WATER RECLAMATION, LOS ANGELES COUNTY, W69-10197	05D	POLYMERS FOR SEWER FLOW CONTROL, THE DEVELOPMENT AND DEMONSTRATION OF THE USE OF POLYMERS TO REDUCE OR ELIMINATE SEWER OVERFLOWS BY FLOW ENERGY REDUCTION. W69-10256	05C
RESEARCH AND DEVELOPMENT FOR REUSE OF WATER, W69-10198	05D	FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF GEOLOGY. URANIUM DISEQUILIBRIUM IN GROUNDWATER AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS. W69-09925	02K
WATER POLICY THEMES AND PROBLEMS FOR THE 1960'S AND 1970'S SUMMARY AND CONTENT, W69-10200	06B	FLORIDA UNIV., GAINESVILLE. CHEMISTRY OF N AND MN IN COX HOLLOW LAKE, W69-09881	05A
WATER RESOURCES RESEARCH, W69-10201	06D	FORD FOUNDATION, NEW YORK AND CARNEGIE INST. OF TECH., PITTSBURGH, PA. SIMULATION OF INDIVIDUAL AND GROUP BEHAVIOR, W69-09950	06A
IMPACTS OF RECREATION ON COMPETITION FOR USE OF WATER, W69-10202	06D	FOREST SERVICE (USDA) TEMPE, ARIZ. ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION. MODIFICATIONS AND EVALUATING OF THE EVAPOTRANSPIRATION TENT. W69-09984	02D
COLORADO UNIV., BOULDER. DEPT. OF BIOLOGY.		FOREST SERVICE (USDA), BERKELEY, CALIF. PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION. LEACHABILITY OF A WETTING-AGENT TREATMENT FOR WATER-RESISTANT SOILS, W69-09989	02G
FIELD AND EXPERIMENTAL WINTER LIMNOLOGY OF THREE COLORADO MOUNTAIN LAKES, W69-10154	02H	FOREST SERVICE (USDA), BERKELEY, CALIF. PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION. MEASURING MOISTURE NEAR SOIL SURFACE. MINOR DIFFERENCES DUE TO NEUTRON SOURCE TYPE. W69-09987	07B
COLUMBIA UNIV., NEW YORK.		FOREST SERVICE (USDA), BERKELEY, CALIF. PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION. EFFECTS OF NEUTRON SOURCE TYPE ON SOIL MOISTURE MEASUREMENT. W69-09986	07B
ON THE INTERPRETATION OF DISCRIMINANT ANALYSIS, W69-09957	06A	MECHANICS AND RATES OF NATURAL SOIL CREEP, W69-09988	07B
COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, ROME (ITALY).		STREAMFLOW RECORDS FROM THE SAN DIMAS EXPERIMENTAL FOREST, 1939-1959, W69-09990	02E
DISTRIBUTION AND CIRCULATION OF THE MAJOR ELEMENTS IN SURFACE WATERS OF ITALY, W69-09922	02K	SOIL WETTABILITY A NEGLECTED FACTOR IN WATERSHED MANAGEMENT, W69-09991	02G
CONSERVATION FOUNDATION, WASHINGTON, D.C.		INSTRUMENTATION FOR SNOW GAGING -- YESTERDAY, TODAY, AND TOMORROW, W69-09992	07B
RESEARCH ON NATURAL RESOURCES A REVIEW AND COMMENTARY, W69-10210	06D	SNOW EVAPORATION REDUCTION MIGRATION OF EVAPORATION SUPPRESSANTS THROUGH SNOW, W69-09993	07B
COPENHAGEN UNIV. (DENMARK). GEOGRAPHICAL LAB.		GAMMA-TRANSMISSION PROFILING RADIOSOTIPE SNOW DENSITY AND DEPTH GAGE, W69-09994	07B
SEDIMENTS FROM DANISH LAKES, W69-10174	02H	ISOTOPE SNOW GAGES FOR DETERMINING HYDROLOGIC	
CORNELL UNIV., ITHACA, N.Y.			
UNSTEADY CIRCULATION IN SHALLOW LAKES, W69-09886	02H		
VISCOS DISSIPATION IN EXTERNAL NATURAL CONVECTION FLOWS, W69-10091	01A		
CORPS OF ENGINEERS, BALTIMORE, MD. NORTH ATLANTIC DIV.			
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN THE DISTRICT OF COLUMBIA. W69-10102	04A		
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN MARYLAND. W69-10103	04A		
CORPS OF ENGINEERS, LITTLE ROCK, ARK.			
FLOODPLAIN INFORMATION, FOURCHE CREEK AND TRIBUTARIES, LITTLE ROCK, ARKANSAS - PART 1. W69-09898	04A		
CORPS OF ENGINEERS, MOBILE, ALA.			
FLOODPLAIN INFORMATION, FIVE MILE CREEK, METROPOLITAN BIRMINGHAM, ALABAMA. W69-09896	04A		
CORPS OF ENGINEERS, SAVANNAH, GA.			
FLOODPLAIN INFORMATION, SWEETWATER, JACKSON, CAMP, BEAVER RUM, AND BROMOLOW CREEKS, METROPOLITAN ATLANTA, GEORGIA. W69-09897	04A		
CORPS OF ENGINEERS, VICKSBURG, MISS.			
FLOOD PLAIN INFORMATION, MISSISSIPPI RIVER AT NATCHEZ, MISSISSIPPI. W69-10086	04A		
DEPARTMENT OF AGRONOMICAL SCIENCES OF THE STATE, GEMBLLOUX (BELGIUM).			
STUDY OF IRRIGATION BY SPRINKLING (FRENCH), W69-09903	03P		

CHARACTERISTICS OF SNOWPACKS, W69-09995	07B	GEOLOGICAL SURVEY, TRENTON, N.J. GROUND-WATER RESOURCES OF ESSEX COUNTY, NEW JERSEY, W69-09933	02F
ISOTOPES -- A MULTIPURPOSE TOOL FOR FOREST WATERSHED RESEARCH, W69-09996	07B	GEOLOGICAL SURVEY, WASHINGTON, D.C. EVALUATION AND CONTROL OF CORROSION AND ENCRUSTATION IN TUBE WELLS OF THE INDUS PLAINS, WEST PAKISTAN, W69-09910	08G
PORTABLE RADIOACTIVE ISOTOPE SNOW GAGES FOR PROFILING SNOWPACKS, W69-09997	07B	GEOLOGY OF PROPOSED POWERSITES AT DEER LAKE AND KASNYKO LAKE, BARANOF ISLAND, SOUTHEASTERN ALASKA, W69-09911	08E
TRANSPORT OF INTERCEPTED SNOW FROM TREES DURING SNOW STORMS, W69-09998	02C	GROUNDWATER IN OGALLALA FORMATION IN THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO, W69-09913	02F
WATERSHED MANAGEMENT EFFECTS ON BASIN DEVELOPMENT, W69-09999	02A	MOVEMENT OF A SOLUTE IN THE POTOMAC RIVER ESTUARY AT WASHINGTON, D.C., AT LOW INFLOW CONDITIONS, W69-09914	05B
A GAMMA-TRANSMISSION GAGE FOR PROFILING SNOWPACK, W69-10000	07B	NUMERICAL SIMULATION OF WAVE-CREST MOVEMENT IN RIVERS AND ESTUARIES, W69-09919	02E
MEASUREMENT OF SNOWPACK PROFILES WITH RADIOACTIVE ISOTOPES, W69-10001	07B	SEDIMENTATION IN BROWNELL CREEK SUBWATERSHED NO. 1, NEBRASKA, W69-09946	04D
FOREST SERVICE (USDA), FORT COLLINS, COLO. ROCKY MOUNTAIN FOREST AND EXPERIMENT STATION. HEATED THERMOPILE ANEMOMETER COMPARED WITH SENSITIVE CUP ANEMOMETER IN NATURAL AIRFLOW, W69-09985	07B	HYDROGEOLOGY OF THE SCIOTO RIVER VALLEY NEAR PIKESTON, SOUTH- CENTRAL OHIO, W69-10105	02F
FOREST SERVICE (USDA), UPPER DARBY, PA. NORTHEASTERN FOREST EXPERIMENT STATION AND PENNSYLVANIA DEPT. OF FORESTS AND WATERS, HARRISBURG. REPORT NO. 4 FOREST AND WATER RESEARCH PROJECT, DELAWARE- LEHIGH EXPERIMENTAL FOREST, W69-10005	02A	PERMAFROST AND RELATED ENGINEERING PROBLEMS IN ALASKA, W69-10106	02C
FOREST SERVICE (USDA), WASHINGTON, D.C. FOREST HYDROLOGY RESEARCH IN THE UNITED STATES, W69-10006	09C	EFFECT OF TECTONIC STRUCTURE ON THE OCCURRENCE OF GROUND WATER IN THE BASALT OF THE COLUMBIA RIVER GROUP OF THE DALLES AREA, OREGON AND WASHINGTON, W69-10107	02F
FOREST SERVICE (USDA), WASHINGTON, D.C. DIV OF WATERSHED, RECREATION, AND RANGE RESEARCH. TECHNIQUES IN GRASSLAND WATERSHED RESEARCH, W69-10007	02A	HYDROLOGY OF A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA, W69-10110	02E
FOREST SERVICE (USDA), WASHINGTON, D.C. DIV. OF WATERSHED, RECREATION, AND RANGE RESEARCH. FORESTS--NATIONAL SUPPLIES AND DEMANDS FOR WATER, W69-10004	03B	DISCHARGE MEASUREMENTS AT GAGING STATIONS, W69-10111	07B
FOREST SERVICE (USDA), WASHINGTON, D.C. AND AGRICULTURAL RESEARCH SERVICE, WASHINGTON, D.C. HYDROLOGY OF FOREST LANDS AND RANGELANDS, W69-10002	02A	WATER RECORDS OF PUERTO RICO, 1958-63, W69-10134	02E
FRANKLIN INST. RESEARCH LABS., PHILADELPHIA, PA. SCIENCE INFORMATION SERVICES. SELECTED URBAN STORM WATER RUNOFF ABSTRACTS. W69-10085	04C	SUMMARY OF HYDROLOGIC AND PHYSICAL PROPERTIES OF ROCK AND SOIL MATERIALS, AS ANALYZED BY THE HYDROLOGIC LABORATORY OF THE U.S. GEOLOGICAL SURVEY, 1948-60, W69-10143	02J
FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND). EVOLUTION AND ADAPTIVE RADIATION IN THE CHYDORIDAE (CRUSTACEA CLADOCERA) A STUDY IN COMPARATIVE FUNCTIONAL MORPHOLOGY AND ECOLOGY, W69-10149	02H	WATER-BEARING CHARACTERISTICS AND OCCURRENCE OF AQUIFERS IN MARTIN COUNTY, NORTH CAROLINA, W69-10144	02F
FRUNZE POLYTECHNIC INST. (USSR). DYNAMICS OF OBJECTS IRRIGATORY SYSTEMS REGULATION, W69-10025	03F	OCURRENCE OF SULFATE AND NITRATE IN RAINFALL, W69-10153	05B
GEODETIC INST., JIHLAVA (CZECHOSLOVAKIA). FLUORINE IN THE REGIONALLY METAMORPHOSED SKARNS OF THE CZECH MASSIF (CZECHOSLOVAKIAN), W69-10123	02K	GEODETIC SURVEY, WASHINGTON, D.C. GEOLOGICAL SURVEY, DENVER, COLO. AND BUREAU OF MINES, SAN FRANCISCO, CALIF. IRMA'S SATURATION FACTOR AS AN INDICATION OF AN IMMOBILE FRACTION OF PORE WATER IN SATURATED PERMEABLE SANDSTONE, W69-09909	02F
GEODETIC SURVEY, BOISE, IDAHO. GROUND-WATER LEVELS IN IDAHO, 1969, W69-10081	02F	GHENT RIJKSUNIVERSITEIT (BELGIUM). INORGANIC CHEMISTRY LAB. AEROBIC TREATMENT OF RESIDUAL BREWERY WATERS, (FRENCH), W69-10088	05D
GEODETIC SURVEY, DENVER, COLO. WATER-LEVEL CHANGES 1964-1968, NORTHERN HIGH PLAINS OF COLORADO, W69-10094	02F	GIDROMETEOROLOGICHESKII INSTITUT, LENINGRAD (USSR). RIVERS AND LAKES OF THE MONGOLIAN PEOPLE'S REPUBLIC (RUSSIAN), W69-09941	02E
GEODETIC SURVEY, JACKSON, MISS. BASIC DATA REPORT NO 3 FOR RESEARCH ON FLOOD FREQUENCY FOR SMALL DRAINAGE AREAS, W69-09895	02E	SHORT-RANGE FORECASTING OF LOWLAND-RIVER RUNOFF, W69-10146	02A
FLOODS OF JULY 2, 1968, IN JACKSON, MISSISSIPPI, W69-10101	02E	GLASGOW UNIV. (SCOTLAND). THE REGIONAL MULTIPLIER--A CRITIQUE, W69-09961	06B
GEODETIC SURVEY, MENLO PARK, CALIF. FLOODS OF JANUARY AND FEBRUARY 1969 IN CENTRAL AND SOUTHERN CALIFORNIA, W69-10089	02E	HARVARD UNIV., CAMBRIDGE, MASS. RESOURCE ALLOCATION WITH PROBABILISTIC INDIVIDUAL PREFERENCES, W69-09956	06C
GEODETIC SURVEY, MINNEAPOLIS, MINN. SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958- SEPT 1967), W69-10093	02E	ON THE EFFICIENT USE OF HIGH ASWAN DAM FOR HYDROPOWER AND IRRIGATION, W69-09972	06A
GEODETIC SURVEY, RIVERTON, WYO. SURFACE-WATER DISCHARGE AND GROUND-WATER LEVELS IN THE EAST FORK RIVER AREA, SUBLLETTE COUNTY, WYOMING, W69-10097	02E	REGIONAL ECONOMICS A SURVEY, W69-09975	06B
GEODETIC SURVEY, ROLLA, MO. WATER RESOURCES DIV. WATER RESOURCES OF THE JOPLIN AREA, MISSOURI, W69-10095	02F	ILLINOIS STATE GEOLOGICAL SURVEY, URBANA. GEOLOGY FOR PLANNING IN MCHENRY COUNTY, W69-09912	06B
		ILLINOIS STATE WATER SURVEY, PEORIA. NATURE OF TURBIDITY IN THE ILLINOIS RIVER, W69-09885	02J
		ILLINOIS STATE WATER SURVEY, URBANA. COMPARISON BETWEEN ANALOG AND DIGITAL SIMULATION TECHNIQUES FOR AQUIFER EVALUATION, W69-09931	07C
		HYDROLOGIC DISTRIBUTIONS RESULTING FROM MIXED POPULATIONS	

AND THEIR COMPUTER SIMULATION, W69-09935	07C	MINISTERSTVO GEOFIZIKI, MOSCOW (USSR) AND VSESOFIYUZNYI NAUCHNO-ISSLEDOVATELSKII INSTITUT YADERNOI GEOFIZIKI I GEOKHIMII, MOSCOW (USSR)
ILLINOIS UNIV., URBANA. DEPT. OF CIVIL ENGINEERING. KINETICS OF REMOVAL OF STARCH IN ACTIVATED SLUDGE SYSTEMS, W69-10258	05D	ISOTOPIC COMPOSITION OF HYDROGEN AS A CLUE TO THE ORIGIN OF GROUND WATERS AND PETROLEUM, W69-10119
INDIANA UNIV., BLOOMINGTON. DEPT. OF BACTERIOLOGY. TEMPERATURE OPTIMA FOR ALGAL DEVELOPMENT IN YELLOWSTONE AND ICELAND HOT SPRINGS, W69-10160	05C	02K
THE HABITAT OF LEUCOTHRIX MUCOR, A WIDESPREAD MARINE MICROORGANISM, W69-10161	05C	MINISTRY OF PUBLIC WORKS AND POWER, DJAKARTA (INDONESIA). WATER RESOURCES DEVELOPMENT.
INDIANA UNIV., BLOOMINGTON. DEPT. OF MICROBIOLOGY. THE MEASUREMENT OF CHLOROPHYLL, PRIMARY PRODUCTIVITY, PHOTOPHOSPHORYLATION, AND MACROMOLECULES IN BENTHIC ALGAL MATS, W69-10151	05C	SEMPOR PROJECT-GENERAL PLAN, W69-10100
THE APPLICATION OF MICRO-AUTORADIOGRAPHIC TECHNIQUES TO ECOLOGICAL STUDIES, W69-10163	07B	08A
INSTITUT PRIRODNOGO GAZA, MOSCOW (USSR). ISOTOPIC COMPOSITION OF ARGON IN GASES DISSOLVED IN GROUND WATER AND IN THE HYDROCARBON DEPOSITS OF THE EASTERN AND CENTRAL PRECAUCASUS, W69-10124	02K	MINNESOTA UNIV., MINNEAPOLIS. LIMNOLOGICAL RESEARCH CENTER. ALGAE AND PHOSPHORUS IN LAKE MINNETONKA, W69-10167
INSTITUTE OF WATER POLLUTION CONTROL, LONDON (ENGLAND). BIOLOGICAL TREATMENT OF TEXTILE EFFLUENTS, W69-10261	05D	05C
IOWA UNIV., IOWA CITY. FRICTION-FACTORS FOR FLAT-BED FLOWS IN SAND CHANNELS, W69-09893	02E	MISSISSIPPI STATE UNIV., STATE COLLEGE. DEPT. OF MICROBIOLOGY.
JOHNS HOPKINS UNIV., BALTIMORE, MD. CHESAPEAKE BAY INST. OBSERVATIONS OF GASES IN CHESAPEAKE BAY SEDIMENTS, W69-09900	02K	THE DECOMPOSITION OF PETROLEUM PRODUCTS IN OUR NATURAL WATERS, W69-10082
JOHNS HOPKINS UNIV., BALTIMORE, MD. AND STANFORD RESEARCH INST., MENLO PARK, CALIF. DISCRETE DYNAMIC PROGRAMMING AND CAPITAL ALLOCATION, W69-10017	06C	05B
KANSAS STATE UNIV., MANHATTAN. DEPT. OF ECONOMICS. IRRIGATION WITH RESTRAINTS ON LAND AND WATER RESOURCES, W69-10189	03F	NEVADA UNIV., RENO. COLL. OF ENGINEERING. AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-10187
KANSAS UNIV., LAWRENCE. DEPT. OF GEOLOGY AND STATE UNIV. OF NEW YORK, ALBANY. ATMOSPHERIC SCIENCES RESEARCH CENTER. INITIAL PERIODICITY OF NEW GEYSER, YELLOWSTONE NATIONAL PARK, W69-10078	02F	03F
KANTONALES LABORATORIUM, ZURICH (SWITZERLAND). ON CONTROL OF LAKE EUTROPHICATION EMPIRICAL AND EXPERIMENTAL INVESTIGATIONS PERTINENT TO THE KNOWLEDGE OF LIMITING CHEMICAL COMPOUNDS IN 46 LAKES OF SWITZERLAND AND BORDER REGIONS--(IN GERMAN), W69-10164	05C	NEVADA UNIV., RENO. DESERT RESEARCH INST. MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER, W69-09918
EUTROPHICATION OF LAKES AND RIVERS ITS ORIGIN AND PREVENTION (IN GERMAN), W69-10170	05C	06A
LENINGRAD STATE UNIV. (USSR). DEPT. OF GEOGRAPHY. EXPERIMENTAL PALEOHYDROLOGIC INVESTIGATIONS, W69-10141	02E	NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF POLITICAL SCIENCE. A STUDY OF THE FEASIBILITY OF SOCIAL SCIENCE RESEARCH DESIGNED TO IDENTIFY AND ANALYZE SOCIAL RESPONSES TO PRECIPITATION MANAGEMENT OPERATIONS IN NEW ENGLAND, W69-10192
LIEGE UNIV. (BELGIUM). DISCHARGE MEASUREMENT IN OPEN CHANNELS BY DILUTION METHODS (FRENCH), W69-09905	07B	06B
MANHATTAN COLL., BRONX, N.Y. DEPT. OF CIVIL ENGINEERING. OPTIMUM WATER QUALITY MANAGEMENT OF STREAM AND ESTUARINE SYSTEMS, W69-10024	05B	NEW MEXICO STATE UNIV., UNIVERSITY PARK. DEPT. OF CIVIL ENGINEERING. EFFECT OF DYE ON SOLAR EVAPORATION OF BRINE, W69-09923
MARINE DEPT. ROTORUA (NEW ZEALAND). OBSERVATIONS ON EXCESSIVE WEED GROWTH IN TWO LAKES IN NEW ZEALAND, W69-10168	05C	02D
MARINE LAB., ABERDEEN (SCOTLAND) AND MICHIGAN STATE UNIV.. HICKORY CORNERS. W. K. KELLOGG BIOLOGICAL STATION. A METHOD FOR THE DETERMINATION OF ZERO THICKNESS ACTIVITY OF CARBON-14 LABELED BENTHIC DIATOMS IN SAND, W69-10150	02L	NEW MEXICO STATE UNIV., UNIVERSITY PARK. ENGINEERING EXPERIMENT STATION. EVAPORATION INVESTIGATIONS AT ELEPHANT BUTTE RESERVOIR IN NEW MEXICO, W69-09934
MARYLAND GEOLOGICAL SURVEY, BALTIMORE. DEPOSITIONAL ENVIRONMENTS OF SUBSURFACE POTOMAC GROUP IN MARYLAND, W69-10113	02J	02D
MASSACHUSETTS INST. OF TECH., CAMBRIDGE. CAPITAL BUDGETING OF INTERRELATED PROJECTS SURVEY AND SYNTHESIS, W69-09971	06A	NEW YORK STATE DEPT. OF HEALTH, ALBANY. DIV. OF LABORATORIES AND RESEARCH STATE UNIV. OF NEW YORK, ALBANY. DEPT. OF BIOLOGICAL SCIENCES AND STATE UNIV. COLL., FREDONIA, N.Y. RADIOECOLOGICAL SURVEILLANCE OF THE WATERWAYS AROUND A NUCLEAR FUELS REPROCESSING PLANT, W69-10080
MICHIGAN STATE UNIV., HICKORY CORNERS, W. K. KELLOGG BIOLOGICAL STATION AND MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF ZOOLOGY. SELF-ABSORPTION OF C-14 RADIATION IN FRESHWATER OSTRACODS, W69-10166	02H	05C
NORTH CAROLINA UNIV., CHAPEL HILL. WATER RESOURCES RESEARCH INTS. WATER RESOURCES RESEARCH INTERESTS IN THE SENIOR COLLEGES AND UNIVERSITIES OF NORTH CAROLINA. W69-10083		
NORTH CAROLINA UNIV., CHAPEL HILL. WATER RESOURCES RESEARCH INTS. INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA. W69-10084		
NORTH CAROLINA WATER RESOURCES RESEARCH INST., RALEIGH. OXYGENATION OF IRON(II) IN CONTINUOUS REACTORS, W69-10293		
WORKSHOP ON WATER RESOURCE PROBLEMS AND RESEARCH NEEDS RELATED TO AGRICULTURE IN THE COASTAL PLAINS OF NORTH CAROLINA. W69-10294		
ANNUAL REPORT, FISCAL YEAR 1969, W69-10295		
NORTHWESTERN UNIV., EVANSTON, ILL. DEPT. OF CHEMICAL ENGINEERING. REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA, W69-10176		
NORTHWESTERN UNIV., EVANSTON, ILL. DEPT. OF GEOLOGY. EVALUATION OF IRREVERSIBLE REACTIONS IN GEOCHEMICAL PROCESSES INVOLVING MINERALS AND AQUEOUS SOLUTIONS--. APPLICATIONS, W69-10092		
NORTHWESTERN UNIV., EVANSTON. DEPT. OF CIVIL ENGINEERING. ECONOMIC EVALUATION OF FLOW AUGMENTATION A SYSTEMS ANALYSIS CASE STUDY, W69-10190		
NORWEGIAN SCHOOL OF ECONOMICS AND BUSINESS ADMINISTRATION, BERGEN. TAXATION AND RISK-TAKING AN EXPECTED UTILITY APPROACH, W69-09963		
OREGON STATE UNIV., CORVALLIS.		

ACTIVITY ANALYSIS IN WATER PLANNING, W69-09982	06B	METROPOLITAN REGION, W69-10023	06A
OSLO UNIV. (NORWAY). SOME NOTES ON THE LINDAHL THEORY OF DETERMINATION OF PUBLIC EXPENDITURES, W69-09951	06B	SCARBOROUGH COLL., TORONTO (ONTARIO). EXTRACELLULAR PRODUCTION IN RELATION TO GROWTH OF FOUR PLANKTONIC ALGAE AND OF PHYTOPLANKTON POPULATIONS FROM LAKE ONTARIO, W69-10158	05C
PENNSYLVANIA DEPT. OF FORESTS AND WATERS, HARRISBURG AND PITTSBURGH UNIV., PA. SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM, W69-10128	05D	SEWER AND WATER ENGINEER, SUDBURY (ONTARIO). COPPER SULPHATE AIR SPRAY CURES LAKE ALGAE PROBLEM, W69-10155	05G
PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF CIVIL ENGINEERING. ALGAL RESPIRATION IN A EUTROPHIC ENVIRONMENT, W69-10159	05B	SMITHSONIAN INSTITUTION, WASHINGTON, D.C. FORAMINIFERAL SPECIES DENSITIES AND ENVIRONMENTAL VARIABLES IN AN ESTUARY, W69-09901	02L
PENNSYLVANIA UNIV., PHILADELPHIA, PA. ALTERNATIVE ASYMPTOTIC TESTS OF SIGNIFICANCE AND RELATED ASPECTS OF 2SLS AND 3SLS ESTIMATED PARAMETERS, W69-09953	06A	SMITHSONIAN INSTITUTION, WASHINGTON, D.C. SCIENCE INFORMATION EXCHANGE. WATER RESOURCES RESEARCH CATALOG, VOLUME FOUR. W69-10115	10
PENNSYLVANIA UNIV., PHILADELPHIA. A NOTE ON THE PARTITIONING OF A SINGLE PRODUCT MARKET INTO TERRITORIES OF OUTLETS, W69-09955	06B	SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION, WAUKESHA. WATER QUALITY AND FLOW OF STREAMS IN SOUTHEASTERN WISCONSIN, W69-09947	05G
PHILIPPINES DEPT. OF PUBLIC WORKS AND COMMUNICATIONS, MANILA. BUREAU OF PUBLIC WORKS. GROUNDWATER RESOURCES OF PAMPANGA PROVINCE, W69-09948	02F	SREDNEAZIATSKII NAUCHNO-ISSLEDOVATELSKII INSTITUT IRRIGATSII, TASHKENT (USSR). METHOD OF DETERMINING THE DISCHARGE OF TWO-LEVEL SPILLWAYS, W69-10129	08B
PITTSBURGH UNIV., PA. LONGITUDINAL DISPERSION IN OPEN CHANNELS, W69-09888	02E	STANFORD UNIV., CALIF. DEPT. OF MINERAL ENGINEERING AND STANFORD UNIV., CALIF. DEPT. OF GEOLOGY. INFRARED EXPLORATION FOR COASTAL AND SHORELINE SPRINGS, W69-09932	07B
POLISH ACADEMY OF SCIENCES, WARSAW. INST. OF GEOGRAPHY. THE PROBLEM OF THORNTONWHITE AND MATHER'S METHOD OF WATER BALANCE IN ITS APPLICATION TO POLAND (POLISH), W69-10127	02A	STATION HYDROLOGICAL INST., LENINGRAD (USSR). TOTAL RUNOFF TRAVEL TIME DURING THE FORMATION OF MIXED 'SURFACE-SUBSURFACE' RAIN FLOODS IN SMALL WATER COURSES, W69-09915	02A
PORTLAND WATER DISTRICT, MAINE. ALGAE CONTROL WITH COPPER SULFATE, W69-10157	05G	INTRA-ANNUAL DISTRIBUTION OF EVAPORATION FROM LAND IN THE USSR, W69-09920	02D
POTOMAC RIVER BASIN ADVISORY COMMITTEE, WASHINGTON, D.C. A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-09954	06E	DETERMINATION OF THE SEASONAL AND MONTHLY EVAPORATION NORMALS FROM AGRICULTURAL FIELDS FROM OBSERVATIONS AT A NETWORK OF STATIONS, W69-09921	02D
PURDUE UNIV., WEST LAFAYETTE, IND. RESERVOIR LOCATION FOR URBAN RECREATION, W69-10022	04C	ANALYSIS OF VARIATIONS IN SOIL MOISTURE STORAGE IN ROW CROP PLANTINGS AS A FUNCTION OF AGROMETEOROLOGICAL FACTORS, W69-10130	02G
RAJASTHAN UNIV., JAIPUR (INDIA). DEPT. OF BOTANY. STUDIES ON MORPHOGENESIS IN A BLUE-GREEN ALGA. I. EFFECT OF INORGANIC NITROGEN SOURCES ON DEVELOPMENTAL MORPHOLOGY OF ANABAENA DOLIOLUM, W69-10177	05C	COMPARATIVE ESTIMATE OF METHODS OF COMPUTING EVAPORATION FROM BODIES OF WATER, W69-10131	02D
RAND CORP., SANTA MONICA, CALIF. A NORMATIVE THEORY OF TRANSFERS, W69-09960	06B	INFLUENCE OF VARIOUS FACTORS ON THE DEPTH OF SOIL FREEZING IN THE CATCHMENTS OF THE NORTHWESTERN EUROPEAN USSR, W69-10132	02A
RESEARCH INST. FOR WATER RESOURCES DEVELOPMENT, BUDAPEST (HUNGARY). FLOW MEASURING STRUCTURES IN THE HYDROLOGICAL OBSERVATION NETWORK, W69-09929	02E	DETERMINATION OF WATER SURFACE TEMPERATURE FROM RADIO EMISSION IN THE CENTIMETER RANGE, W69-10140	07B
RESEARCH INST. FOR WATER RESOURCES DEVELOPMENT, BUDAPEST (HUNGARY). DEPT. FOR HYDRAULIC ENGINEERING RESEARCH. SUMMARY OF HYDRAULIC ENGINEERING RESEARCH SINCE 1958, W69-09939	08A	INVESTIGATION OF A METHOD OF MEASURING SNOW STORAGE BY USING THE GAMMA RADIATION OF THE EARTH, W69-10142	02C
RESOURCES FOR THE FUTURE, INC., WASHINGTON, D.C. COMPARISONS IN RESOURCE MANAGEMENT, W69-09952	06B	STATE UNIV. OF NEW YORK, BUFFALO. THE FRESH WATER OF NEW YORK STATE ITS CONSERVATION AND USE, W69-09969	06B
THE RANGE OF CHOICE IN WATER MANAGEMENT, W69-09964	05G	SUPERINTENDENCIA DO DESENVOLVIMENTO DO NORDESTE (BRAZIL) AND GEOLOGICAL SURVEY, WASHINGTON, D.C. HYDROGEOLOGY OF THE UPPER CABIBARIBE BASIN PERNAMBUCO, BRAZIL A RECONNAISSANCE IN AN AREA OF CRYSTALLINE ROCKS, W69-10145	02F
NEW HORIZONS IN WATER RESOURCES ADMINISTRATION, W69-09977	06B	TECHNICAL UNIV. OF DENMARK, COPENHAGEN. DISPERSION OF FLOATING PARTICLES IN UNIFORM CHANNEL FLOW, W69-09887	02J
ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES, W69-09983	06B	TECHNICAL UNIV. OF ISTANBUL (TURKEY). RESISTANCE TO REVERSING FLOWS OVER MOBILE BEDS, W69-09892	02E
A FRAMEWORK FOR DEALING WITH THE URBAN ENVIRONMENT INTRODUCTORY STATEMENT, W69-10206	06B	TEXAS A AND M UNIV., COLLEGE STATION AND TEXAS UNIV., AUSTIN. GEOMETRIC PROGRAMMING NEW OPTIMIZATION TECHNIQUE FOR WATER RESOURCE ANALYSTS, W69-10020	06A
ROME UNIV. (ITALY). INSTITUTO DI ECONOMIA E FINANZA. ON THE PURE THEORY OF PUBLIC GOODS, W69-09966	06C	TEXAS UNIV., AUSTIN. CARNEGIE-MELLON UNIV., PITTSBURGH, PA. AND OFFICE OF CIVILIAN MANPOWER MANAGEMENT (Navy), WASHINGTON, D.C. STATIC AND DYNAMIC ASSIGNMENT MODELS WITH MULTIPLE OBJECTIVES, AND SOME REMARKS ON ORGANIZATION DESIGN, W69-10018	06A
RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N. J. WATER RESOURCES RESEARCH INST. HYDROLOGICAL AND HYDROLOGICAL DROUGHT IN RARITAN RIVER BASIN IN NEW JERSEY, W69-10184	02A	TEXAS UNIV., AUSTIN. INFLUENCE OF SEDIMENTS ON SOLUTE TRANSPORT, W69-09891	05B
RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N.J. ARIZONA V. CALIFORNIA -- A BRIEF REVIEW, W69-10212	06E	TRANSIENT STRESSES AND DISPLACEMENT AROUND A WELLBORE DUE TO FLUID FLOW IN TRANSVERSELY ISOTROPIC, POROUS MEDIA IN FINITE RESERVOIRS, 2	
RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N.J. BARNARD COLL., NEW YORK AND COLUMBIA UNIV., NEW YORK. LINEAR PROGRAMMING OF WATER TRANSFERS IN THE NEW YORK			

W69-09926	08E	WASHINGTON UNIV., SEATTLE. DEPT. OF ZOOLOGY AND WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
ROCK FAILURE DURING TOOTH IMPACT AND DYNAMIC FILTRATION, W69-09927	08E	SOME FEATURES OF SALINE LAKES IN CENTRAL WASHINGTON, W69-10165 02H
TEXAS WATER DEVELOPMENT BOARD, AUSTIN. SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE, W69-10292	06A	WASHINGTON UNIV., SEATTLE. DEPT. OF ZOOLOGY. ARTIFICIAL EUTROPHICATION OF LAKE WASHINGTON, W69-10169 05C
TEXAS WATER QUALITY BOARD, AUSTIN. WATER REUSE A TEXAS NECESSITY, W69-09882	05D	CHANGES IN THE OXYGEN DEFICIT OF LAKE WASHINGTON, W69-10182 05C
UNIVERSITY COLL., LONDON (ENGLAND). DEPT. OF BOTANY. THE IMPORTANCE OF EXTRACELLULAR PRODUCTS OF ALGAE IN FRESHWATER, W69-10180	05C	WATER PLANNING FOR ISRAEL LTD., HAIFA. PLANNING APPROACHES TO WATER RESOURCES DEVELOPMENT AND UTILIZATION IN ISRAEL, W69-10026 06A
UPPSALA UNIV. (SWEDEN). DEPT. OF PHYSICAL GEOGRAPHY. GLACIAL ACCUMULATIONS, DRAINAGE AND ICE RECEDITION IN THE NARVIKSKJOMEN DISTRICT, NORWAY, W69-09924	02C	WATER SUPPLY BOARD, PROVIDENCE, R.I. THE RECENT 5-YEAR DROUGHT ON SCITUATE WATERSHED AND NEARBY DRAINAGE BASINS IN RHODE ISLAND AND MASSACHUSETTS, W69-10188 02E
VIRGINIA POLYTECHNIC INST., BLACKSBURG, VA. STOCHASTIC MODEL FOR BOD AND DO IN ESTUARIES, W69-09879	05B	WESTON (ROY F.), INC., WEST CHESTER, PA. OPTIMIZATION MODELS FOR RIVER BASIN WATER QUALITY MANAGEMENT AND WASTE TREATMENT PLANT DESIGN, W69-10021 05G
DISTRIBUTION OF PESTICIDES IN SURFACE WATERS, W69-09884	05B	WISCONSIN DEPT. OF RESOURCE DEVELOPMENT, MADISON. WATER RESOURCES DIV. EXCESSIVE WATER FERTILIZATION, W69-10178 05C
PROBLEMS IN THE THEORY OF PUBLIC CHOICE SOCIAL COST AND GOVERNMENT ACTION, W69-09958	06C	WISCONSIN UNIV., MADISON. MONTE CARLO SIMULATION OF WASTE DISCHARGE, W69-09880 05B
VIRGINIA POLYTECHNIC INST., BLACKSBURG. DEPT. OF CIVIL ENGINEERING. INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS, W69-10098	02A	SIMULATION OF ECONOMIC SYSTEMS, W69-09949 06A
VIRGINIA POLYTECHNIC INST., BLACKSBURG. DEPT. OF GEOLOGICAL SCIENCE. GEOLOGIC CONTROL OF RAINFALL-RUNOFF RELATIONS IN THE PEAK CREEK WATERSHED, PULASKI AND WYTHE COUNTIES, VIRGINIA, W69-10090	02A	COLLECTIVE-CONSUMPTION SERVICES OF INDIVIDUAL-CONSUMPTION GOODS, W69-09974 06C
VIRGINIA POLYTECHNIC INST., BLACKSBURG. WATER RESOURCES RESEARCH CENTER. PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS, W69-10011	06A	WISCONSIN UNIV., MADISON. WATER CHEMISTRY LAB. PSEUDOMONAS AEROGINGSA FOR THE EVALUATION OF SWIMMING POOL CHLORINATION AND ALGICIDES, W69-10171 05F
VSESOIUZNYI NAUCHNO-ISSLEDOVATELSKII INSTITUT NEFTEKHIMICHESKIKH PROTSESSOV, LENINGRAD (USSR). ANALYSIS OF DISTRIBUTION OF ARGON IN GROUND WATERS, W69-10120	02K	WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS. THE RELATIONSHIP OF THE DISTRIBUTION OF THE DIATOM SKELETONEMA TROPICUM TO TEMPERATURE, W69-10162 05C
VSESOIUZNYI NAUCHNO-ISSLEDOVATELSKII INSTITUT NEFTEKHIMICHESKIKH PROTSESSOV, MOSCOW (USSR). ISOTOPIC COMPOSITION OF SULFUR IN AQUATIC PLANTS AND DISSOLVED SULFATES, W69-10133	02K	WYOMING STATE ENGINEER'S OFFICE, CHEYENNE. COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS, W69-10213 07A
VULCAN MATERIALS CO., BIRMINGHAM, ALA. COMMENT ON ECONOMY OF WATER QUALITY MANAGEMENT AND POLLUTION CONTROL, W69-09965	05G	WYOMING UNIV., LARAMIE. CONCEPT OF REASONABLE BENEFICIAL USE IN THE LAW OF SURFACE STREAMS, W69-09979 06E
		YALE UNIV., NEW HAVEN, CONN. ECONOMICS AND THE ADMINISTRATION OF NATIONAL PLANNING, W69-09978 06B

ACCESSION NUMBER INDEX

05B	W69-09879	06E	W69-09954	04D	W69-10029	02A	W69-10104
05B	W69-09880	06B	W69-09955	04D	W69-10030	02F	W69-10105
05A	W69-09881	06C	W69-09956	04D	W69-10031	02C	W69-10106
05D	W69-09882	06A	W69-09957	06F	W69-10032	02F	W69-10107
05C	W69-09883	06C	W69-09958	06E	W69-10033	02A	W69-10108
05B	W69-09884	06B	W69-09959	06E	W69-10034	02J	W69-10109
02J	W69-09885	06B	W69-09960	05B	W69-10035	02E	W69-10110
02H	W69-09886	06B	W69-09961	05B	W69-10036	07B	W69-10111
02J	W69-09887	06C	W69-09962	05B	W69-10037	02A	W69-10112
02E	W69-09888	06B	W69-09963	05B	W69-10038	02J	W69-10113
06E	W69-09889	05G	W69-09964	06E	W69-10039	02K	W69-10114
06E	W69-09890	05G	W69-09965	06E	W69-10040	10	W69-10115
05B	W69-09891	06C	W69-09966	06E	W69-10041	02K	W69-10116
02E	W69-09892	05G	W69-09967	06E	W69-10042	02K	W69-10117
02E	W69-09893	05G	W69-09968	06E	W69-10043	02K	W69-10118
07C	W69-09894	06B	W69-09969	06E	W69-10044	02K	W69-10119
02E	W69-09895	06B	W69-09970	06E	W69-10045	02K	W69-10120
04A	W69-09896	06A	W69-09971	06E	W69-10046	02K	W69-10121
04A	W69-09897	06A	W69-09972	06E	W69-10047	01R	W69-10122
04A	W69-09898	06B	W69-09973	06E	W69-10048	02K	W69-10123
02B	W69-09899	06C	W69-09974	06E	W69-10049	02K	W69-10124
02K	W69-09900	06B	W69-09975	06E	W69-10050	02K	W69-10125
02L	W69-09901	06A	W69-09976	06E	W69-10051	03B	W69-10126
02A	W69-09902	06B	W69-09977	06E	W69-10052	02A	W69-10127
03F	W69-09903	06B	W69-09978	06E	W69-10053	05D	W69-10128
07B	W69-09904	06E	W69-09979	06E	W69-10054	08R	W69-10129
07B	W69-09905	06B	W69-09980	06E	W69-10055	02G	W69-10130
02L	W69-09906	06E	W69-09981	06E	W69-10056	02D	W69-10131
06E	W69-09907	06B	W69-09982	06E	W69-10057	02A	W69-10132
02L	W69-09908	06R	W69-09983	06E	W69-10058	02K	W69-10133
02F	W69-09909	02D	W69-09984	06E	W69-10059	02E	W69-10134
08G	W69-09910	07B	W69-09985	06E	W69-10060	04B	W69-10135
08E	W69-09911	07B	W69-09986	06E	W69-10061	02D	W69-10136
06B	W69-09912	07B	W69-09987	06E	W69-10062	05C	W69-10137
02F	W69-09913	07B	W69-09988	06E	W69-10063	02C	W69-10138
05B	W69-09914	02G	W69-09989	06E	W69-10064	05C	W69-10139
02A	W69-09915	02E	W69-09990	06E	W69-10065	07B	W69-10140
07B	W69-09916	02G	W69-09991	06E	W69-10066	02E	W69-10141
02F	W69-09917	07B	W69-09992	06E	W69-10067	02C	W69-10142
06A	W69-09918	07B	W69-09993	06E	W69-10068	02J	W69-10143
02E	W69-09919	07B	W69-09994	06E	W69-10069	02F	W69-10144
02D	W69-09920	07B	W69-09995	06E	W69-10070	02F	W69-10145
02D	W69-09921	07B	W69-09996	05G	W69-10071	02A	W69-10146
02K	W69-09922	07B	W69-09997	06E	W69-10072	02F	W69-10147
02D	W69-09923	02C	W69-09998	06F	W69-10073	02K	W69-10148
02C	W69-09924	02A	W69-09999	06E	W69-10074	02H	W69-10149
02K	W69-09925	07B	W69-10000	06E	W69-10075	02L	W69-10150
08E	W69-09926	07B	W69-10001	06E	W69-10076	05C	W69-10151
08E	W69-09927	02A	W69-10002	06E	W69-10077	05C	W69-10152
02G	W69-09928	02J	W69-10003	02F	W69-10078	05R	W69-10153
02E	W69-09929	03B	W69-10004	05C	W69-10079	02H	W69-10154
02D	W69-09930	02A	W69-10005	05C	W69-10080	05G	W69-10155
07C	W69-09931	09C	W69-10006	02F	W69-10081	02H	W69-10156
07B	W69-09932	02A	W69-10007	05B	W69-10082	05G	W69-10157
02F	W69-09933	06E	W69-10008	09C	W69-10083	05C	W69-10158
02D	W69-09934	06A	W69-10009	09A	W69-10084	05R	W69-10159
07C	W69-09935	06E	W69-10010	04C	W69-10085	05C	W69-10160
06A	W69-09936	06A	W69-10011	04A	W69-10086	05C	W69-10161
07C	W69-09937	06A	W69-10012	06B	W69-10087	05C	W69-10162
06A	W69-09938	06B	W69-10013	05D	W69-10088	07B	W69-10163
08A	W69-09939	06A	W69-10014	02F	W69-10089	05C	W69-10164
06D	W69-09940	06B	W69-10015	02A	W69-10090	02H	W69-10165
02F	W69-09941	06A	W69-10016	01A	W69-10091	02H	W69-10166
02F	W69-09942	06C	W69-10017	01R	W69-10092	05C	W69-10167
05B	W69-09943	06A	W69-10018	02E	W69-10093	05C	W69-10168
06D	W69-09944	02F	W69-10019	02F	W69-10094	05C	W69-10169
06E	W69-09945	06A	W69-10020	02F	W69-10095	05C	W69-10170
04D	W69-09946	05G	W69-10021	02F	W69-10096	05F	W69-10171
05G	W69-09947	04C	W69-10022	02E	W69-10097	02K	W69-10172
02F	W69-09948	06A	W69-10023	02A	W69-10098	02K	W69-10173
06A	W69-09949	05B	W69-10024	08B	W69-10099	02H	W69-10174
06A	W69-09950	03F	W69-10025	08A	W69-10100	06F	W69-10175
06B	W69-09951	06A	W69-10026	02E	W69-10101	05G	W69-10176
06B	W69-09952	06E	W69-10027	04A	W69-10102	05C	W69-10177
06A	W69-09953	04D	W69-10028	04A	W69-10103	05C	W69-10178

ACCESSION NUMBER INDEX

04A	W69-10179	06D	W69-10210	04A	W69-10241	05D	W69-10272
05C	W69-10180	06D	W69-10211	05G	W69-10242	05D	W69-10273
02H	W69-10181	06E	W69-10212	04A	W69-10243	05D	W69-10274
05C	W69-10182	07A	W69-10213	04A	W69-10244	05D	W69-10275
06F	W69-10183	06B	W69-10214	04A	W69-10245	05G	W69-10276
02A	W69-10184	06R	W69-10215	05G	W69-10246	05G	W69-10277
04A	W69-10185	06C	W69-10216	06R	W69-10247	05G	W69-10278
06E	W69-10186	06B	W69-10217	04A	W69-10248	05D	W69-10279
03F	W69-10187	06F	W69-10218	06E	W69-10249	05D	W69-10280
02E	W69-10188	06E	W69-10219	04A	W69-10250	05D	W69-10281
03F	W69-10189	06B	W69-10220	04A	W69-10251	05D	W69-10282
05G	W69-10190	06E	W69-10221	05D	W69-10252	05D	W69-10283
06D	W69-10191	05G	W69-10222	05D	W69-10253	05D	W69-10284
06R	W69-10192	04A	W69-10223	05D	W69-10254	05G	W69-10285
06E	W69-10193	04A	W69-10224	05G	W69-10255	05D	W69-10286
06R	W69-10194	04A	W69-10225	05C	W69-10256	05G	W69-10287
06R	W69-10195	04A	W69-10226	05D	W69-10257	05D	W69-10288
06R	W69-10196	06E	W69-10227	05D	W69-10258	05D	W69-10289
05D	W69-10197	06E	W69-10228	05D	W69-10259	05D	W69-10290
05D	W69-10198	06E	W69-10229	05D	W69-10260	05D	W69-10291
06E	W69-10199	06E	W69-10230	05D	W69-10261	06A	W69-10292
06B	W69-10200	06F	W69-10231	05G	W69-10262	05D	W69-10293
06D	W69-10201	04A	W69-10232	05D	W69-10263	03F	W69-10294
06D	W69-10202	04A	W69-10233	05D	W69-10264	09D	W69-10295
06B	W69-10203	04A	W69-10234	05G	W69-10265	05G	W69-10296
06F	W69-10204	04A	W69-10235	05D	W69-10266	05G	W69-10297
05D	W69-10205	04A	W69-10236	05D	W69-10267	04B	W69-10298
06R	W69-10206	04C	W69-10237	05D	W69-10268	04C	W69-10299
06E	W69-10207	04A	W69-10238	05D	W69-10269	05F	W69-10300
06R	W69-10208	04A	W69-10239	05D	W69-10270		
06E	W69-10209	04A	W69-10240	05D	W69-10271		

ABSTRACT SOURCES

Source	Accession Numbers	Total
A. Centers of Competence		
University of Wisconsin - Eutrophication	W69-10148 .. 10174 10176 .. 10178 10180 .. 10182	33
U.S. Geological Survey - Hydrology	W69-09879 .. 09888 09891 .. 09906 09908 .. 09944 09946 .. 09948 10078 .. 10147	136
North Carolina State University - Textile Wastes	W69-10257 .. 10291	35
Rutgers - State University - Water Resources Economics	W69-09949 .. 09967 09969 .. 09983 10187 .. 10192	40
University of Florida - Eastern U.S. Water Law	W69-10027 .. 10077 10214 .. 10251 10296 .. 10300 09889, 09890, 09907, 09945, 09968, 10008, 10010, 10175, 10179, 10183, 10185, 10186	106
Cornell University - Policy Models for Water Resources Systems	W69-10011 .. 10026 10009	17
University of Chicago - Metropolitan Water Resources Management	W69-10193 .. 10212	20
B. Others:		
Forest Service - U.S. Department of Agriculture	W69-09984 .. 10007	24
Federal Water Pollution Control Administration - U.S. Department of the Interior	W69-10252 .. 10256	5
University of North Carolina - Water Resources Research Institute	W69-10293 .. 10295	3
New Jersey Water Resources Research Institute	W69-10184	1
Texas Water Development Board	W69-10292	1
Wyoming Water Resources Research Institute	W69-10213	1
	Total	422

Subject Fields

NATURE OF WATER

WATER CYCLE

WATER SUPPLY AUGMENTATION
AND CONSERVATION

WATER QUANTITY MANAGEMENT
AND CONTROL

WATER QUALITY MANAGEMENT
AND PROTECTION

WATER RESOURCES PLANNING

RESOURCES DATA

ENGINEERING WORKS

MANPOWER, GRANTS, AND
FACILITIES

SCIENTIFIC AND TECHNICAL
INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES



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